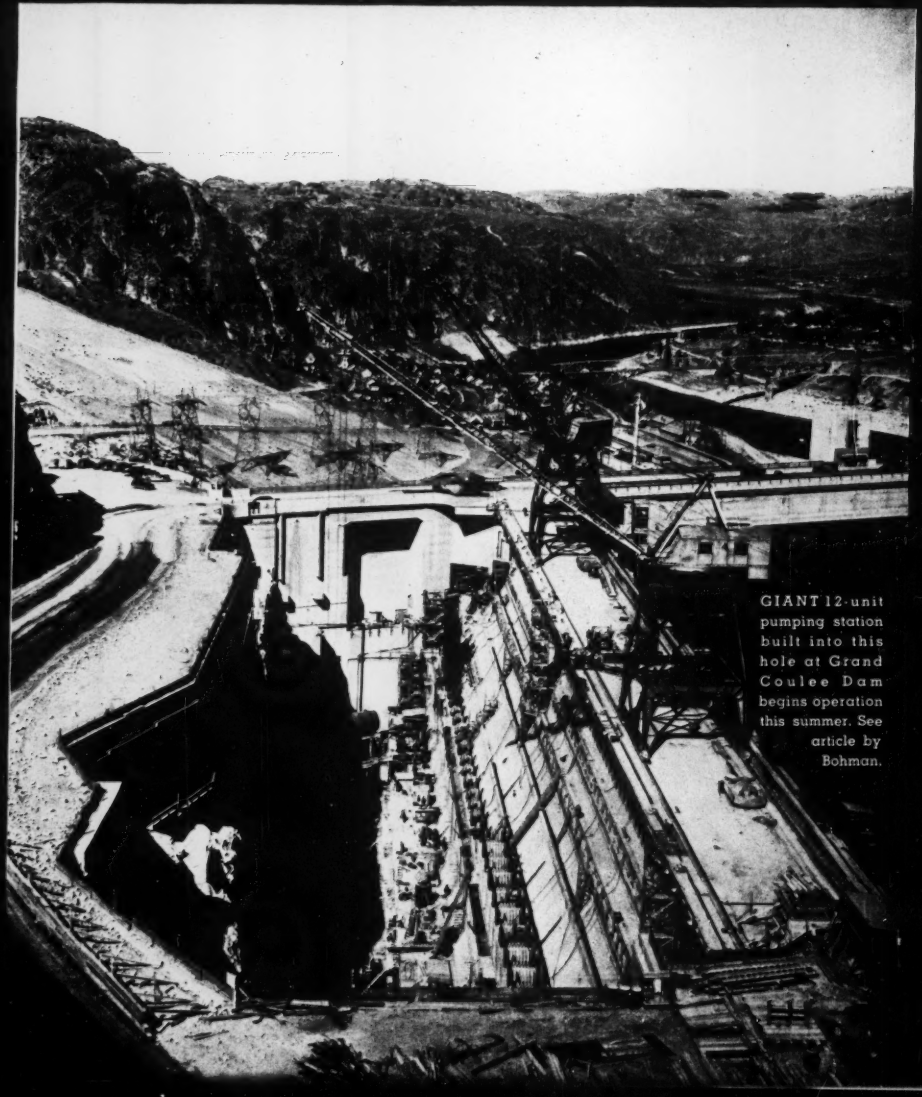
CIVIL ENGINEERING



GIANT 12-unit pumping station built into this hole at Grand Coulee Dam begins operation this summer. See article by Bohman.

Raymond

MAKES 5 TYPES OF CONCRETE PILES

1. STANDARD . . . 2. STEP-TAPER . . . 3. PIPE STEP-TAPER

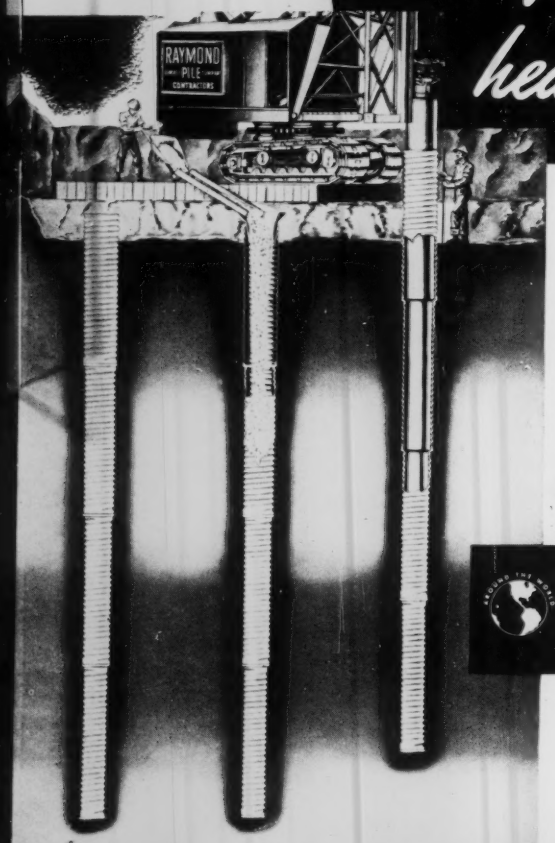
4. COMPOSITE . . . 5. GOW CAISSONS

Raymond installs every type of pile: cast-in-place concrete, precast concrete, steel pipe, wood and H-beam. Raymond operations include underpinning, borings and soil investigations, waterfront construction and harbor and river improvements, and cement mortar lining of oil and water pipe lines 4" to 144" in diameter by the Centriline Corporation, a Raymond subsidiary.

At left, completed Step-Taper Pile. Center, filling the permanent steel shell with concrete after internal inspection. Right, driving the pile with rigid core.

2. STEP-TAPER PILES

FOR *long lengths* WITH *heavy loads*



Raymond Step-Taper Concrete Piles driven with rigid steel cores and heavy hammers are designed to develop high load-carrying capacities at depths to 80 feet. The permanent steel shell maintains the resistance developed during driving. After the shell is inspected internally, it is filled with concrete and cut off at the specified elevation.

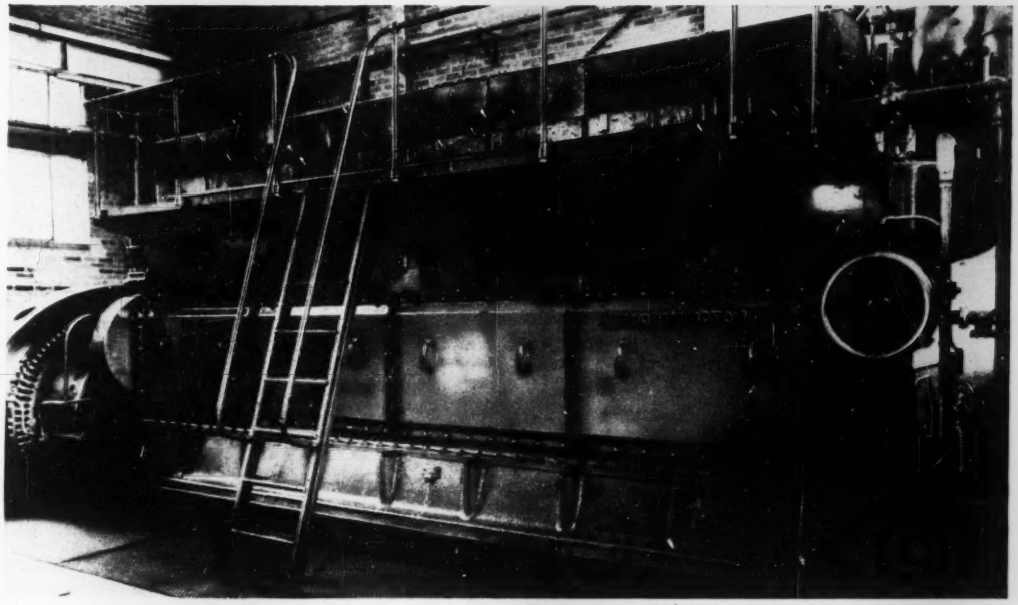
You are invited to discuss with our engineers the efficiencies and savings made possible by Raymond's exclusive, original concrete pile designs.

◀ RAYMOND PILES MAINTAIN DRIVING RESISTANCE

Raymond CONCRETE PILE CO.

140 CEDAR ST., NEW YORK 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America.



Worthington 8-cylinder 4-cycle turbo-charged Diesel engine—one of the two operated by Elko-Lamoille Power Company. This 1000 Kw-rated engine was installed on the same foundation originally built for an engine with 250-Kw rating.

Lesson in Cost Reduction

FROM THE MIDDLE OF THE DESERT

If you've never heard of Elko, you'll find this story interesting.

Elko is the seat of a county in Nevada that, all by itself, is larger than Massachusetts, Connecticut and Rhode Island together, with Delaware thrown in. Since pioneer days, it has been a transportation and trading center.

Elko's present power plant set-up, which includes two four-cycle turbo-charged Worthington Diesel engines connected to 1000-Kw generators, contrasts with the single 50-hp steam engine purchased second-hand in 1896 from a nearby silver mine.

Cost of power has never been more reasonable. Ever since 1940 when fuel oil cost this plant less than half what it does now, power rates have *gone down*—having been reduced twice during the period. Today, 87% of the power is produced by the two Worthington units, and in 1950 the plant averaged 13.3 Kw-hrs per gallon of fuel.

Lubricating oil consumption is low, too—well below the estimated 4,000 rated horsepower hours per gallon.

Want more evidence that there's *more worth in Worthington?* Write Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.

WORTHINGTON

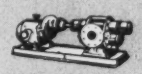
E.1.11

ECONOMICAL CONTINUOUS POWER

Diesel Engines, 150 to 2640 hp
Gas Engines, 190 to 2880 hp
Dual Fuel Engines, 345 to 2640 hp

WORTHINGTON-BUILT AUXILIARIES

Balanced Angle Compressors



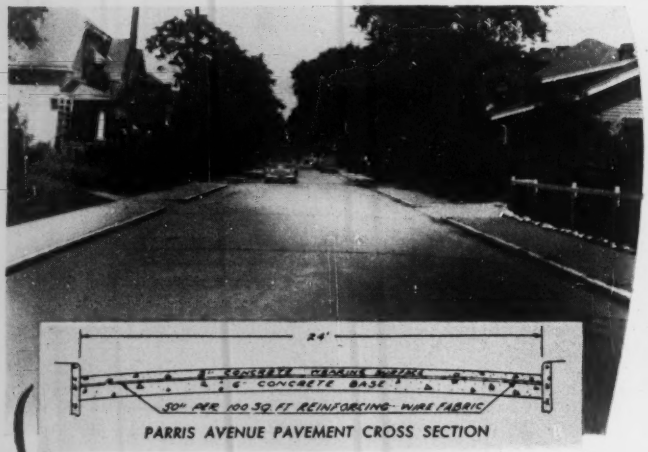
Oil Transfer Pumps

Cooling Water Circulating Pumps

Evaporative Type Engine Water Coolers

CIVIL ENGINEERING, The Magazine of Engineered Construction, June, 1951. Vol. 21, No. 6. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

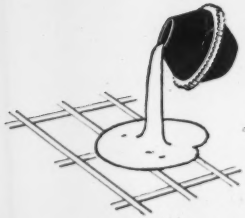
Make First Pavements *Last* with American Welded Wire Fabric



PARRIS AVENUE PAVEMENT CROSS SECTION

THESE PAVEMENTS were laid on 43rd Street in the month of June, 1924, and on Parris Avenue, both in Indianapolis, Indiana, in the month of October, 1923. The unretouched photos show that both are still in first class condition in the year 1950. The diagrams show details of construction, which, except for variations in width and thickness, are the same as those used in the latest interurban highways and city streets.

43rd STREET PAVEMENT CROSS SECTION



THE two streets illustrated here were paved with concrete, reinforced with American Welded Wire Fabric, in 1923 and 1924 respectively. They are still, as you can see, in first class condition. And on hundreds of thousands of miles of concrete highways and streets all over the country, American Welded Wire Fabric reinforcement also assures long years of trouble-free service.

U·S·S American Welded Wire Fabric has definite structural superiority to other forms of concrete reinforcement. It distributes the strength of steel evenly throughout the concrete, fortifies the slabs against all-directional stresses, provides positive control of any cracking that may occur and forms a secure bond with the concrete.

When next you consider paving, be sure you are fully informed upon the superior riding qualities, safety and durability of concrete, reinforced with American Welded Wire Fabric. And remember, on a cost per year basis it is the most *economical* pavement for streets and highways.

Many standard designs and sizes of American Welded Wire Fabric are now readily available from jobbers' and dealers' stocks, supplemented by prompt mill shipments to identified projects. Our technical staff will be glad to consult with you regarding your individual requirements. Literature which contains valuable information is yours for the asking. Just drop a line to our nearest sales office.

You use less concrete, less steel (of a non-critical type) for slabs of comparable strength with this modern fabric reinforcement. This conservation of materials, plus savings in construction time and cost, makes the use of American Welded Wire Fabric more important than ever now—when every hour, every dollar saved is an important contribution to the all-out mobilization effort.

AMERICAN STEEL & WIRE COMPANY
GENERAL OFFICES: CLEVELAND, OHIO

COLUMBIA STEEL COMPANY, SAN FRANCISCO
PACIFIC COAST DISTRIBUTORS

TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
SOUTHERN DISTRIBUTORS

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Every concrete paving job needs

USS

AMERICAN WELDED WIRE FABRIC
reinforcement

UNITED STATES STEEL

leakage is STOPPED

WITHOUT REMOVING THIS PIPE FROM THE GROUND, holes resulting from exterior or interior corrosion have been permanently filled by the thin coating of cement mortar mechanically applied to the interior of the pipe by the Centriline process . . . Internal corrosion has been *eliminated*. Centrilining also increases the pipe's flow capacity and cuts pumping costs . . . The ingenious Centriline machine utilizes centrifugal force in applying the cement. Pipes in diameters of 4" to 144" can be lined by Centriline at a *fraction* of the cost of installing new pipes. Make pipes better than new through cement lining.

OUR ENGINEERS ARE READY TO HELP YOU... WRITE TODAY

CENTRILINE CORPORATION

CEMENT MORTAR LININGS
FOR NEARLY 3,000,000
FEET OF WATER, OIL
AND GAS MAINS . . .

A subsidiary of Raymond Concrete Pile Co.
140 CEDAR STREET, NEW YORK 6, N. Y.
Branch Offices in Principal Cities of United States and Latin America

ON THE WEST COAST, WRITE AMERICAN PIPE & CONSTRUCTION COMPANY
P. O. BOX 3428, TERMINAL ANNEX, LOS ANGELES, CALIFORNIA

STRENGTH is vital

Be doubly sure when you specify pipe for mains to be laid under city pavements. Sure that it effectively resists corrosion. Sure, also, that it has the four strength factors, listed opposite, that pipe must have to withstand beam stresses, external loads, traffic shocks and severe working pressures. *No pipe, deficient in any of these strength factors, should ever be laid in paved streets of cities, towns or villages.* Cast iron water and gas mains, laid over a century ago, are serving in the streets of more than 30 cities in North America. These attested service records prove that cast iron pipe not only assures you of effective resistance to corrosion but all of the vital strength factors of long life and economy.

in pipe for city streets

No pipe that is deficient in any of the following strength factors should ever be laid under paved streets.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

CAST IRON PIPE SERVES FOR CENTURIES

MORETRENCH WELLPOINTS CUT SEWER CONSTRUCTION COSTS . . .

NOTE:

1. Wellpoints needed on one side of trench only, lowering installation, operation, removal costs.
2. Sheeting eliminated.
3. Dry excavation — easy, quick—economical.

Frank Nero and Son has 50,000 feet of sewer to lay in Lavallette, N. J. Nine feet of water in sand layered with clay and peat bog form a handicap.

But this is an experienced contractor. He wastes no time, spends no money fighting water.

He does install a MORETRENCH WELLPOINT SYSTEM for a quick start and a profitable finish — "IN THE DRY".

If you've been avoiding wet jobs, get acquainted with Moretrench's low-cost pumping performance. An estimate is yours for the asking.

Catalog on request

MORETRENCH CORPORATION

90 West St. New York 6 | 4900 S. Austin Ave. Chicago 38, Illinois | 7701 Interbay Blvd. Tampa 9, Florida | 315 W. 25th St. Houston 8, Texas | Rockaway New Jersey

Canadian Representative: Geo. W. CROTHERS Limited, Toronto, Ontario

New Orleans' famed Cabildo and Cathedral of St. Louis in the Vieux Carré as seen 100 years ago

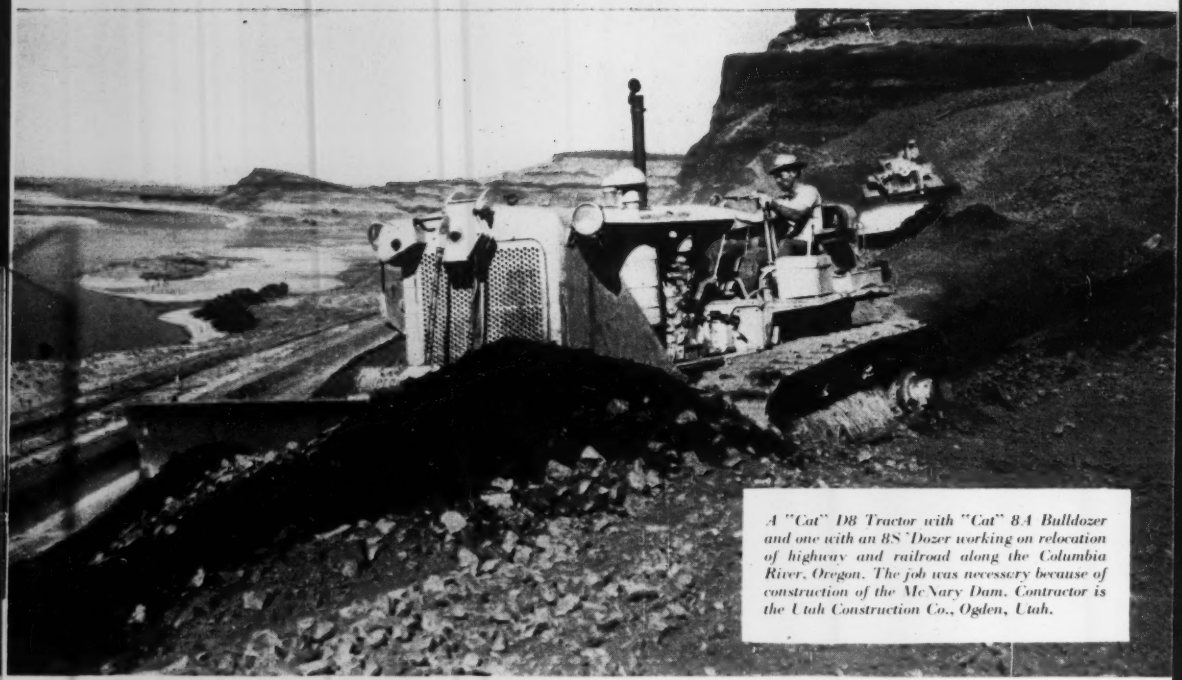
New Orleans has a cast iron gas main in service that was installed well over 100 years ago. Vehicular traffic in those times was a far cry from today's giant buses and trailer trucks. The engineering term—*traffic shock*—was then unheard of. There were no sewers, conduits and other underground services to cause soil disturbance. Yet this old cast iron main has had the shock-strength, beam-strength and effective resistance to corrosion to withstand the changes and unforeseen stresses of more than a century. New Orleans' experience is not exceptional. Cast iron water and gas mains, laid over a century ago, are still serving in the streets of more than 30 cities in the United States and Canada.

United States Pipe and Foundry Co.,
General Offices, Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.

U.S. CAST IRON PIPE

NUMBER SIX OF A SERIES

There's a big



A "Cat" D8 Tractor with "Cat" 8A Bulldozer and one with an 8S "Dozer working on relocation of highway and railroad along the Columbia River, Oregon. The job was necessary because of construction of the McNary Dam. Contractor is the Utah Construction Co., Ogden, Utah.

IF YOU WANT TO HELP YOUR COUNTRY— AND YOURSELF AT THE SAME TIME— READ EVERY WORD ON THESE TWO PAGES

Keeping equipment *on the job* is of prime importance today—to the nation as well as the contractor. The Military plans to spend 8 to 9 billions on construction in the next 18 months. And a production *backlog* of 52 billions was carried over into 1951 for bridges, roads, earthwork, government work, waterworks and other essential projects.

Right now there is a shortage of materials with which to build urgently needed machines and parts. Military and Defense Rated Orders get the nod over unclassified civilian needs. Steel and other materials are in short supply. This means that you—with our help—must get every last machine-power hour out of the equipment and parts you now have.

Down-time will not only weaken the defense effort, it can put the contractor himself in the hole. To get future business, he must get current jobs done without penalty or sacrificing his bond. Down-time means bad distribution of equipment: it means costly damage to equipment forced to do work it's not built to handle.

So to stay in business profitably, and help America arm for defense, do these things now:

1 Use equipment properly. "Cat" machines are built for hard use—not abuse.

2 Give *extra* attention *now* to preventive maintenance (see next page).

3 Have your equipment superintendent plan *ways and means* with your "Caterpillar" dealer. His maintenance responsibility begins where your operators' and mechanics' responsibility ends. He has the skilled servicemen and equipment to rework and rebuild worn parts to keep your machines on the job longer.

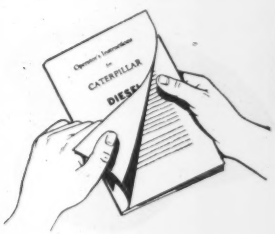
CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

The last war showed the Military that "Cat" Earthmoving Equipment was as important to defense and offense as tanks. Here Sgt. Robert Chrisman operates a "Cat" D7 Tractor with matching blade on Davison airstrip at Ft. Belvoir, Va.

job ahead!

You're the Doctor

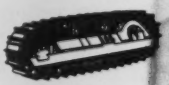
Today no owner can afford to think of direct costs alone. Good care of equipment can mean the difference between a producing machine and one laid up for repairs. To see how good care can save many hours of equipment life, reread your Operator's Instruction Book often and follow these suggestions.



• DUST

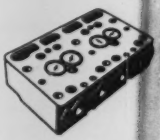
Think of dust as Machine Enemy No. 1. A few grains today—a few more tomorrow—and soon the result adds up to serious wear. Dust or dirt plugged breathers or air cleaners—use of dirty oil containers—loose intake manifolds—loose inspection covers—dirty clutch compartment—failure to wash flywheel clutch compartment—worn seals on crankshaft—defective gaskets—failure to clean oil filter openings . . . these are some of the vulnerable spots.

• TRACK ASSEMBLY



Don't let abusive use or neglect cripple the service life of your track assembly. Track adjustment and lubrication of rollers, carrier rollers and idlers are your job. Before excessive wear occurs on grousers, links, pins, bushings, idlers, rollers and sprockets, call in your "Caterpillar" dealer. He can build up grousers, rollers, idlers and links, and replace sprocket rims and turn pins and bushings so you will have many additional hours of service.

• CYLINDER HEADS



Prevent cracked cylinder heads by avoiding overheating, freezing, scale deposits, filling a hot engine with cold water, pulling heads down too tight, and other poor maintenance practices. Your "Caterpillar" dealer can repair most cracked cylinder heads. He can replace worn valve seats with valve inserts and restore the rocker arm mechanism to serviceable limits. Consult your Operator's Instruction Book for proper cooling system and valve care.

• COOLING

Don't let your engine overheat. Keep the cooling system free of scale, rust and sediment. Use soft or treated water, and when freezing temperatures exist, protect your engine with anti-freeze. Clean the radiator regularly with chemical flushing solutions. Remove foreign matter from the core by brushing or washing. Prevent engine troubles which come with overheating. Consult your Operator's Instruction Book for proper cooling system care.

• LUBRICATION

Careful lubrication practices will add much to your satisfaction through equipment performance, economy and long life. Use *only* recommended lubricants, changing the lubricant at proper intervals. And use *only* "Caterpillar"-proved filter elements. Remove dirt from fittings and clean around the crankcase filler cap before adding oil. A little care saves many hours of engine life. Consult the lubrication chart in your Operator's Instruction Book.

• PISTONS AND LINERS

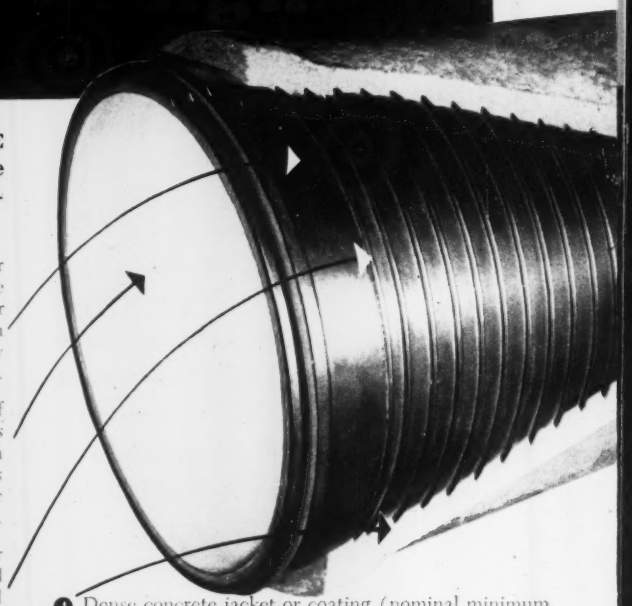
Almost all the piston wear occurs in the upper ring groove. Your "Caterpillar" dealer can renew your pistons by machining the upper ring groove for a wide ring, many sizes of which are chrome plated. Worn liners can be deglazed and put back to work for many additional hours of service life. Consult your Operator's Instruction Book for information on lubrication and the oil cooling system.

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

In AMERICAN CONCRETE CYLINDER PIPE these *four* advanced design features give you *greater strength* with *greatest economy* of steel components.



❶ Steel cylinder provides a positive water seal or membrane, as well as part of the required total steel area*. (Thickness of the cylinder varies according to pipe diameters and general design requirements). Each cylinder is hydrostatically tested to a unit stress of at least 22,000 psi.

❷ Centrifugally spun concrete lining is of proper mixture and dense compaction. Its thickness adds rigidity and strength through "arching" effect (nominal minimum lining thickness is ½" for 14" and 16" diameters and ¾" for larger diameters). Cylinder is lined prior to rod wrapping.

❸ Steel reinforcing rods, which together with the steel cylinder provide the total required cross-sectional steel area*, are wrapped under measured tension and accurate spacing around the concrete lined cylinder. The section modulus is thus increased while the concrete lining is placed under slight initial compression. The result is, in effect, a modified prestressed design.

❹ Dense concrete jacket or coating (nominal minimum 1" thickness over the cylinder) is "locked" around the rod wrapping over the entire surface of the cylinder. This is an important structural feature.

*Total cross sectional steel area is based on 13,500 psi max. allowable unit stress at the design operating pressure.

When selecting pressure pipe for your permanent water transmission main, do not overlook the inherent strength of American Concrete Cylinder Pipe to meet all normal conditions of internal pressures and external loads.

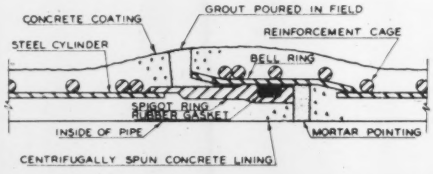
Economy of design, together with maximum sustained carrying capacity, ease of installation, and minimum of maintenance all contribute to the reduced cost of delivered water throughout generations of dependable service.

In practical tests for Underwriters' Laboratories, Inc., several sections of pipe were installed under 10' of earth cover and changes of inside diameter were measured by machinists' calipers at several points along each section. Average results were as follows —

	Vertical Diameters in inches	Horizontal Diameters in inches
42" Dia. Pipe	Minus .314	Plus .318
30" Dia. Pipe	Minus .052	Plus .050
21" Dia. Pipe	Minus .010	Plus .009

Subsequent examination of the concrete linings disclosed that they were sound and unimpaired under these extraordinary earth loads.

Throughout the West this superior pipe is demonstrating its advantages in actual operation. Complete information upon request.



American PIPE AND CONSTRUCTION CO.

Concrete Pipe for Main Water Supply Lines, Storm and Sanitary Sewers, Subaqueous Pipe Lines

P.O. Box 3428, Terminal Annex, Los Angeles 54, California
Main Offices and Plant—4635 Firestone Blvd., South Gate, Calif.

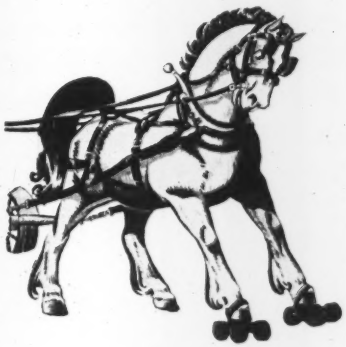
District Sales Offices and Plants—
Oakland • San Diego • Portland, Ore.

No matter how you say it

It Comes Out the Same

Last Year – This Year – Next Year

in 1940 we said

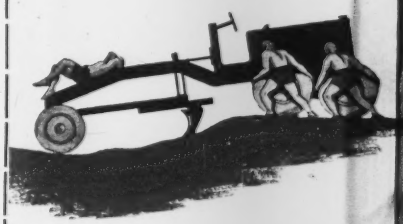


A motor grader without power on the front wheels is like a horse with roller skates on his front feet.

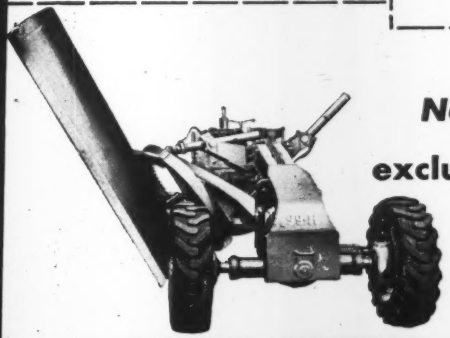
in 1945 we said

It's not in the cards for a grader with rear drive to equal the performance of one with All-Wheel Drive.

in 1950 we said



Don't handicap your horsepower! No grader with a dead front end can possibly deliver maximum power-at-the-blade.



No two ways about it! **Austin-Western's exclusive All-Wheel Drive goes more places . . . does more things . . . moves more material, farther and faster.**

AUSTIN-WESTERN COMPANY, AURORA, ILL., U. S. A.

REPAIR COSTS ON DORR TYPE S (ROUND) CLARIFIERS

SIZE	100'-200' DIA.	UNDER 100' DIA.
PURCHASE PERIOD	1931-42	1932-35
YEARS IN SERVICE	4-15	11-14
NUMBER OF UNITS	115	95
TOTAL REPAIR COSTS	$3,568	$2,933
PER UNIT	$31	$31
TOTAL REPAIR COST FOR ENTIRE PERIOD AS % OF ORIGINAL COST	0.27	.77

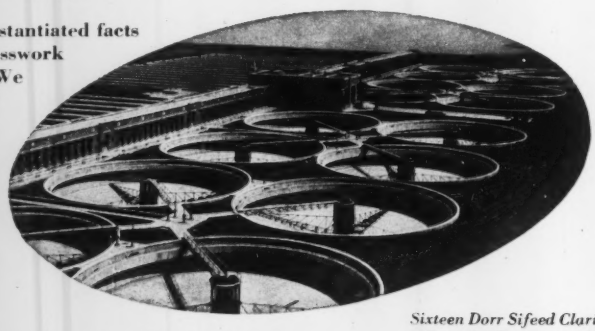
✓ Check these facts...

ON DORR CLARIFIER MAINTENANCE COSTS!

A glance at the figures above will tell you exactly what repair costs can be expected with Dorr Clarifiers.

These figures are substantiated facts ... not estimates, guesswork or wishful thinking. We believe they cannot be matched.

Repair costs are one of the primary factors upon which Clarifier excellence should be judged. Are you getting the best?



Sixteen Dorr Sifeed Clarifiers at Easterly Treatment Plant, Cleveland, Ohio, installed in 1932.

We'd like to tell you how Dorr Clarifiers stack up on performance too. Ask a Dorr engineer for the facts.

DORRCO

DORR

WORLD-WIDE RESEARCH · ENGINEERING · EQUIPMENT

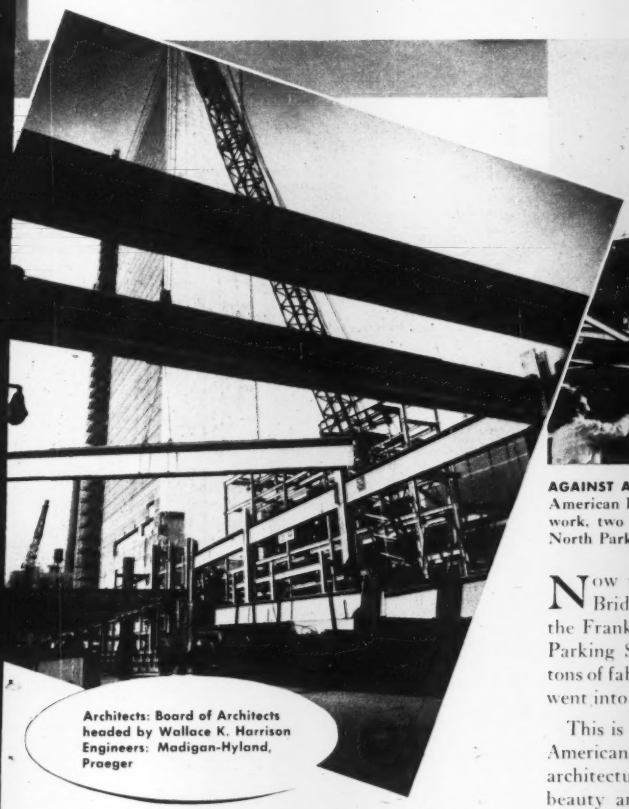
THE DORR COMPANY · ENGINEERS · STAMFORD, CONN.

Associated Companies and Representatives in the principal cities of the world

3 new structures for the United Nations

...fabricated and erected by the

AMERICAN BRIDGE COMPANY



Architects: Board of Architects headed by Wallace K. Harrison
Engineers: Madigan-Hyland, Praeger

AMERICAN BRIDGE BEGINS erection of the steel framework for the cover of the Franklin D. Roosevelt Drive at the UN Headquarters. Eventually the entire drive from 42nd St. to 48th St. at East River will be covered. In the right foreground steel framework for the Meeting Halls Building can be seen. When completed, this building will extend, by cantilever construction, over the drive to the edge of the river.

AVAILABLE NOW! *For showing in churches, schools, clubs, and industries, the new sound and color motion picture— BUILDING FOR THE NATIONS a candid, factual photographic record of the highlights of the fabrication and erection of the United Nations' Secretariat Building in New York City.*

AGAINST A BACKGROUND of the completed UN Secretariat Building, for which American Bridge Company fabricated and erected 13,800 tons of structural steelwork, two bridgemen direct the unloading of steel columns and beams for the North Parking Space at the UN site.

Now that the UN Secretariat Building is completed, American Bridge is erecting the Meeting Halls Building and cover for the Franklin D. Roosevelt Drive, General Assembly Hall and North Parking Space. When finished these structures will contain 18,600 tons of fabricated steel framework, in addition to the 13,800 tons which went into the Secretariat Building.

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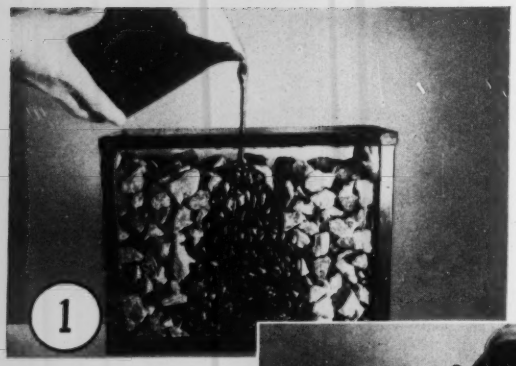

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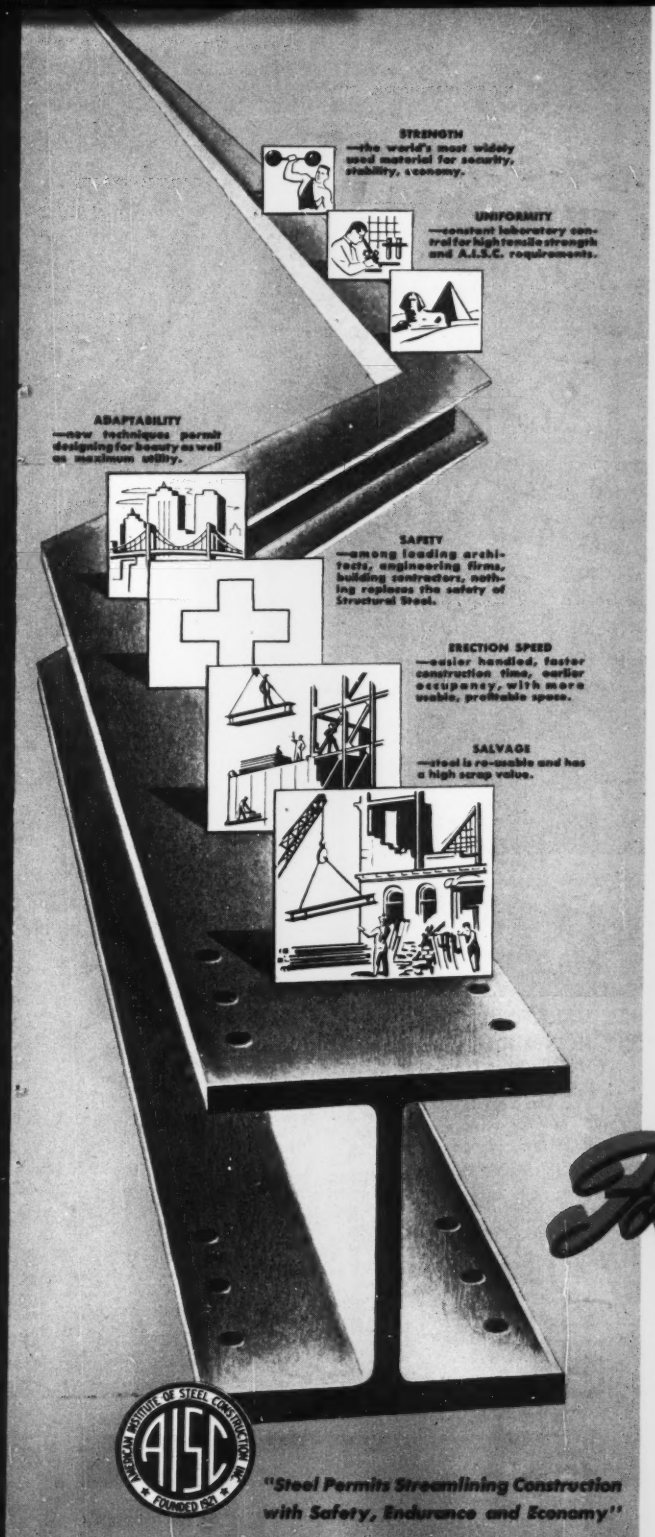
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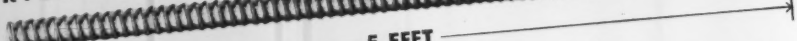

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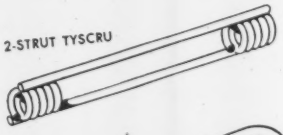

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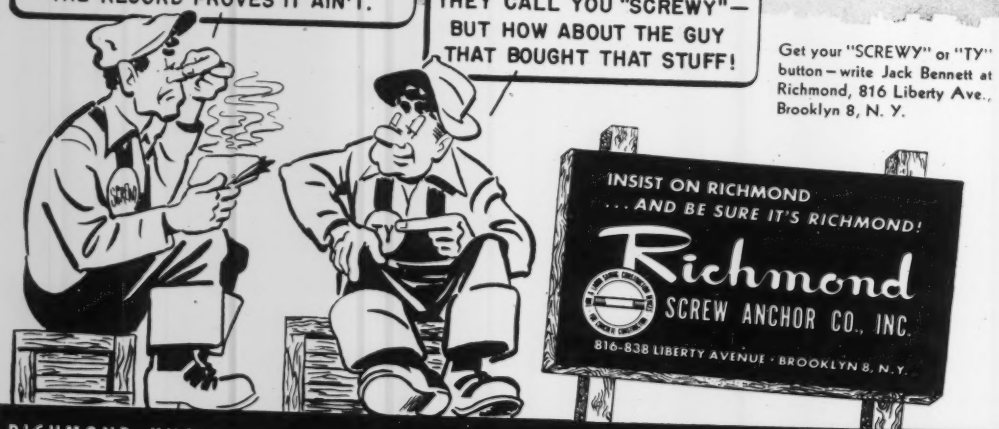

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Carl A. Menzel (left) receives the 1951 C. R. S. I. Award from Henry G. Turner, Jr., President of the Turner Construction Company and Chairman of the Award Committee. The presentation was made on April 19, at the 27th Annual Meeting of the C. R. S. I. held at The Homestead, Hot Springs, Virginia.

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CARL A. MENZEL is well known to the engineering profession for his research and development work in concrete and concrete products. In 1932, he received ASTM's Dudley Medal, and in 1948, ACI's Wason Medal for research in concrete problems. He is also the author of many papers on the subject. Mr. Menzel is a graduate of the University of Illinois.

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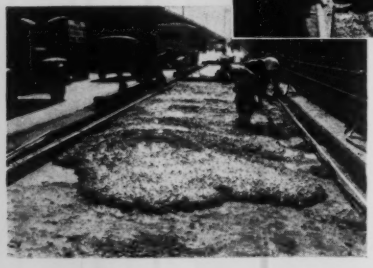

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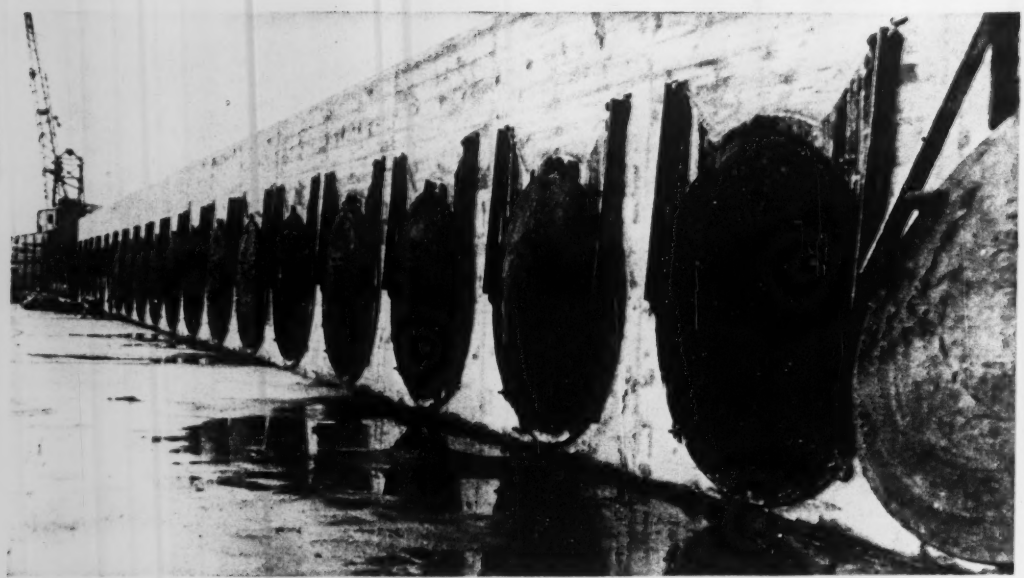


Behind-the-scenes story of operations of 2nd Engineer Special Brigade

Evacuation of Hungnam—

WILLIAM McCOLLAM, JR., Captain, CE

Assistant Operations Officer, 2nd Engineer Special Brigade

I AM PROUD of the important part played in the evacuation of Hungnam by the 2nd Engineer Special Brigade, and by the other Engineer units which participated with such distinction. The difficulties and problems confronting the 2nd Engineer Special Brigade in this task were enormous, and the remarkable success of the operation is a tribute not only to the Brigade and its reinforcing units, but also to the Navy, Marine Corps, and Air Force, whose units and personnel demonstrated a high degree of cooperation and teamwork.

Any person who may doubt the sincerity and good faith of the American effort in upholding the principles of the United Nations may well take note of the consideration given to civilian refugees, even at the calculated risk of endangering the entire operation.

I congratulate Brig: Gen. Joseph J. Twitty (then Colonel), the Brigade Commander, and every other Engineer soldier in the 2nd Engineer Special Brigade and attached Engineer units who added this brilliant page to the distinguished achievements of the Corps of Engineers in war and in peace.

LEWIS A. PICK
Major General, USA
Chief of Engineers

U. S. Army Photograph

THE SUCCESSFUL evacuation of an American Corps of over 100,000 troops with all its impedimenta and equipment through the port of Hungnam, north Korea, in December 1950 is an operation whose magnitude and complexity are without parallel in military history. Other mass evacuations such as that of the British at Gallipoli during World War I and at Dunkirk during World War II were not as complete and unhurried as the withdrawal of the United Nations at Hungnam. Not only were all personnel of a reinforced corps successfully redeployed, but all equipment and supplies as well. Not a piece of usable equipment was left behind. The real superiority of this operation over past tactical evacuations was in its completeness and orderliness in spite of the fact that the Reds moved against the beachhead in great strength and launched repeated abor-

(Vol. p. 319)

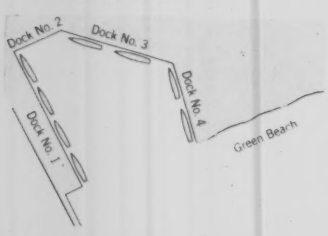
tive attacks against it. However, complete air and naval superiority kept the enemy at bay while plans were rapidly made and executed. It is these plans and their execution, the behind-the-scene story at Hungnam, which this article relates.

General MacArthur made the statement after World War II that it was an engineers' war, thus recognizing the many and varied functions which engineers performed in support of his operations in the Pacific. Such a statement is just as applicable now to the operations in Korea. Engineers are continuing to perform important combat and service missions.

The missions of operating the port of Hungnam and of providing engineer support for X Corps in this area had been assigned to the 2nd Engineer Special Brigade when the port was declared officially opened in the middle of November. After the completion of mine-sweeping operations, and at the time evacuation plans were secretly announced, the Brigade was still operating the port. The Brigade Commander was also the Port Commander of Hungnam from the time it was opened until its final evacuation on December 24, 1950. Considerably below full mobilization strength and at that time performing a mission somewhat alien to its normal role of landing tactical units over an open beach, the Brigade was assigned the responsibility of outloading all the Corps elements, including its own units, through the port in a period of two weeks. The magnitude of the task and the short time allowed for its accomplishment were a challenge to each member of the organization.

It would be well at this point to describe briefly the existing facilities of the port and the additional construction which had to be undertaken concurrent with the outloading at the time the evacuation began to insure the success of the operation. (See Fig. 1.)

FIG. 1. DOCKSIDE FACILITIES for outloading at Hungnam were limited to berths for eight ocean-going vessels. LST's and lighters for vessels anchored in stream operated off Green Beach.



Dock No. 1 was available for berthing four vessels, Dock No. 3 two vessels, and Dock No. 4 two vessels. Dock No. 2 was relatively short and was utilized as a landing point for small boats. A considerable amount of port reconstruction such as road construction and improvement, rehabilitation and expansion of the existing railroad net, development of Green Beach, and rehabilitation of port utilities and usable buildings had been undertaken and successfully completed prior to the planned evacuation. This reconstruction had materially increased the facilities of the port and had rendered it capable of handling the evacuation of X Corps with little added construction.

However, some new construction was necessary to ready the port for the reception of cargo, vehicles, and personnel of the Corps, and new projects had to be undertaken as late as the day before the tactical exodus. Among these projects were the clearing of additional assembly areas in the port, the erection of about 100 squad tents as transient billets, and the repair of rail lines damaged by the numerous tracked vehicles traversing the port area. The facility with which these projects could be successfully completed decreased materially as the outloading progressed, since the Brigade and its attached units were continually evacuating small numbers of their own personnel and equipment as the opportunity presented itself.

The plans for the evacuation of X Corps from northeast Korea through the port of Hungnam were secretly announced by the Corps Commander on December 9, 1950, and at this time the 2nd Engineer Special Brigade was assigned by verbal order (later confirmed in writing) the missions of operating staging areas and outloading all Corps units. The Brigade's inadequate strength was promptly recognized by the Corps Commander, who immediately augmented the unit by the attachment of an engineer construction battalion, two military police companies, two engineer combat companies, a battery of anti-aircraft artillery (less equipment) and a reinforced shore-party company of Marines, in addition to a company of amphibious tanks, less equipment, already attached. This action did not preclude the necessity for later levying stevedore crews from the units being outloaded. Indigenous labor, relatively plentiful in the early stages of port operation, became increasingly scarce as the Reds approached, and had to be almost completely replaced in the later stages by soldier labor. Considerations of security at a time when the port area was particularly vulnerable to sabotage was also a factor in sharply limiting the use of what indigenous labor was still available.

Brigade Reorganized

On receipt of its orders the Brigade underwent a hasty reorganization to better equip it for executing its assigned missions. Maximum utilization of dockside facilities for ocean-going vessels and of Green Beach for LST's and lighterage to ships in the stream being loaded simultaneously was essential. A specific definition of responsibility for each of these functions was felt by the Brigade Commander to be of prime importance. The major subordinate unit of the Brigade, the 532d Engineer Boat and Shore Regiment, was assigned the responsibility for the loading of all vessels dockside, excluding those which were later double-banked to ships occupying berths at the docks.

The mission of operating Green Beach was assigned to a provisional shore-party battalion organized for the particular task from organic service elements of the Brigade and its attached units. This provisional unit was commanded by the S-4 of the Brigade, and drew from all its major staff sections for sufficient officer personnel to permit round-the-clock operation. The troop nucleus of this organization was a reinforced shore-party company of the 1st Marine Shore Party Battalion, augmented by Companies A and C, 73rd Engineer Combat Battalion, Battery C, 115th AAA Battalion, and some special troops from the Brigade.

Security of the port became the sole responsibility of A Company, 56th Amphibious Tank and Tractor Battalion, which established a series of outposts around the port perimeter and organized a mobile riot squad which could be moved to the scene of any disorder at a moment's notice. The mission of traffic control logically fell to the 58th and 88th Military Police Companies, which set up a rigid system of control both in the port area and along the main roads leading into it. The necessity for outloading over 18,000 vehicles of the Corps in such a short period of time demanded that traffic snarls be held to an absolute minimum. No convoys were permitted to enter the limited port area unless they were specifically earmarked for immediate loading aboard some ship or for move-

U.S. Army Photographs

EVACUATION OF HUNGNAM included over 100,000 civilian refugees as well as 100,000 military personnel and all their equipment. At right, an LST takes aboard a load of Korean refugees. Above, men of X Corps file aboard LCVP's in what is probably history's most complete and successful amphibious redeployment operation.

ment into a predesignated vehicle assembly area.

The tasks of clearing additional assembly areas and of establishing and operating staging areas for units being outloaded were assigned to the 79th Engineer Construction Battalion, a proven veteran of the atomic bomb tests in the Pacific atolls. Six large vehicle assembly areas were rapidly cleared at strategic points throughout the port, a tent city of 100 squad tents was erected immediately behind Green Beach, and a transient mess, capable of feeding personnel around the clock, was set up in this staging area. Many other minor construction jobs were assigned to the 79th Engineers during the evacuation period, which they performed with consummate skill and celerity.

Both Dockside and Lighterage Loading Employed

The over-all plan called for the loading of Victory-type ships dockside, larger ships of deeper draft in the stream by lighterage, and LST's on Green Beach. Victory ships carried vehicles and organizational bulk with relatively few personnel. Most of the troops were outloaded to the large transports in the stream by LSU's and LCM's. One notable exception to this plan was the outloading of Republic of Korea troops aboard Victory ships and certain APA's. This particular operation was accomplished by lighterage from Green Beach to the ships, which were double banked to other vessels being loaded dockside. This practice saved much valuable time by materially shortening the distance from shore to ship and by insuring a calm sea at all times for loading. Although this method of loading occasionally interfered with operations dockside, the added capacity it afforded to the port more than justified its continued use during the rest of the evacuation.

To insure maximum utilization of all available berths dockside, strict scheduling in moving vessels in and out of the dock area was essential. So complete was the engineer responsibility for the operation that even the important functions of harbor master and pilot were performed by an engineer officer. The superior job which this officer did resulted in a smooth and rapid movement of ships in and out of berths. No usable dockside space remained empty longer than it took to move the next ship from the anchorage area into position for loading.

All the clocklike precision in ship movements would have been rendered void had not similar coordination been effected in the movement of units and equipment to dockside berths and beach slots when they were scheduled to go aboard. Priorities for the outloading of major units of X Corps were established by the Corps Commander in consonance with the tactical plan for the evacuation. The 1st Marine Division, which had recently succeeded in extricating itself from the Choisin Reservoir area with relatively heavy casualties, was given first priority, and its elements began loading upon arrival at Hungnam.

The Marines were followed in rapid succession by the 7th Infantry Division and the 3rd Infantry Division in that order, with miscellaneous Corps units phasing out as the situation permitted. A steady stream of personnel, vehicles and cargo flowed through the port of Hungnam from the 11th to the 23rd of December. When all but the final tactical covering force had been successfully evacuated, one vehicle per minute for 12 days, day and night, had moved through the port.

Not only were all the units with their organic equipment and impedimenta outloaded during this period, but a considerable number of unserviceable ordnance vehicles, large quantities of all classes of supplies, and over 100,000 refugees were also successfully removed from the area. The control of the tactical situation was so complete that the decision was made by the Corps Commander that nothing of potential value to the enemy would be left behind. Even railroad boxcars recently shipped from Japan for use by ECA in the planned economic rehabilitation of the country were loaded back aboard ship for redeployment to other areas. Among the unserviceable ordnance vehicles outloaded were heavy tanks and other tracked vehicles whose condition, in many cases, presented problems in moving them to ships. Rations, POL, and ammunition of all types represented by far the largest proportion of the supplies removed from the beachhead, and these supplies were outloaded up until the last day that ships were in the dock area.

Civilian Refugees Evacuated

The evacuation of refugees was a major operation in itself and deserves some special mention. During the early stages, Korean LST's and small ships of the FS type were loaded to capacity with civilians, who were almost frantic to escape from the approaching Reds. Later, several Victory ships were also made available for this purpose, and refugees were taken off the beachhead in a continuous stream until the last hour of the operations. Statistics released by the Navy show that a total of over 100,000 refugees were removed from the area. The hard realities of war were tempered by consideration for these destitute and homeless people, but at the risk of jepoardizing the major evacuation. It was a bold decision which demonstrated the good faith of the United Nations in

upholding the principles for which their legions fought.

There were many problems incident to this evacuation. In the first place, the masses of refugees which converged on the port area on several occasions seriously hampered other loading operations, particularly in the Green Beach area. On these occasions it became necessary to dispatch several squads of military police to control the groups and clear them from the beach. The second major problem was one of security. Since any number of the thousands of refugees might have been Communists, important port installations might have been sabotaged when the handicap thus imposed could have been ill afforded. Large quantities of gasoline and ammunition being outloaded presented particularly vulnerable targets for such acts of sabotage, and increased vigilance on the part of all engaged in the operation became essential.

Concurrent with the outloading operation, a certain amount of highly selective unloading had to be accomplishe in order to meet urgent requirements. Mogas was particularly short, and enough of this item had to be unloaded to provide for normal daily consumption until all motor vehicles had been evacuated. Likewise, certain types of ammunition and engineer fortification materials had to be brought in to insure the success of the tactical phase of the evacuation.

Air-raid alerts at night during the evacuation hampered progress somewhat, as they resulted in blackouts and cessation of operations for the duration of the alert. And after the all-clear signal was sounded, there was always a certain amount of inertia which had to be overcome. Several such shutdowns in one night often resulted in loss of valuable time. Fortunately, none of these air raids ever materialized, a fact which is difficult to comprehend in view of the enemy's capabilities and the peculiar vulnerability of the port area.

Practically coincident with the beginning of the evacuation, civilian electric power in the Hamhung-Hungnam area was cut off when power sources in the vicinity of Tanchon fell into Communist hands. This eventuality had been foreseen, and provision had been made to bring in a converted destroyer escort as a source of power during the evacuation. Utilizing local skilled labor, the Brigade's provisional Port Engineer organization had made all the preparations to tie in the ship's generators to existing transformers, and when civilian power failed a smooth phase over to the DE's power was effected.

The heavy round-the-clock commitments of the 2nd Engineer Special Brigade in performing its mission in this operation added an interesting variation to approved army doctrine. Nearly every staff officer of the Brigade and Regiment was placed "in the line" to fill in either on Green Beach or on the dock. Had this not been done, there would not have been enough officers to supervise the many jobs in the evacuation to which the unit fell heir. Some of the staff officers served as expeditors at the various berths in the dock area, where close coordination was essential, rendering periodic reports on the progress of loading. Their efforts were directed principally toward assisting the TQM's, many of whom were inexperienced in this type of work, and insuring prompt corrective action where it was required. Other staff officers filled in on Green Beach with the provisional shore-party battalion which had the responsibility for loading all LST's and lighterage to larger ships in the stream. The wealth of experience which these officers had accumulated in this and similar types of work paid big dividends when the chips were down.

As the defense perimeter in the Hungnam area shrank with evacuation of more and more units, close surveillance had to be kept over the real estate in the port area, which was in great demand by many units. The need for assembly areas had to be weighed against the increasing tactical requirements for artillery positions, the need for billeting areas and vehicle parks for units displacing to the rear, and the necessity for temporary dump areas and issue points to handle the logistical demands of the remaining units. All differences were settled by arbitration.

Final Exodus Had Four Phases

The 3rd Division was the last tactical unit to be evacuated, and the 2nd Engineer Special Brigade tied its plans to those of the 3rd, which called for four phases in the final exodus. All bulk and nonessential service troops were outloaded in Phase 1, which began on December 19. This was followed closely by Phase 2, during which the remainder of the service troops and 155-mm artillery were evacuated. All remaining artillery, tanks, half tracks, and vehicles (except for several jeeps carried out in the final waves) were removed in Phase 3. Phase 4 was the final tactical getaway on D-Day. The 2nd Engineer Special Brigade completed its mission at daylight on December 24, when the last LST's were loaded and its Green Beach detachment boarded an LCM as the infantry could be seen moving down from the hills. On that same morning the Corps Commander met with the Brigade Commander at 1,000 hours for a final inspection of the port, departing at 1,100 to embark on the *Mt. McKinley*.

The mission of destroying all shore installations and thus denying their future use to the enemy was assigned to Navy underwater demolition teams, who worked feverishly preparing the port area for demolition during the closing days of the evacuation. At 1535 hours on December 24, 1950, a mighty blast was detonated and the port of Hungnam was an effective installation no more.

The announcement by the Navy of the redeployment of 215,000 personnel, 18,000 vehicles, and 350,000 tons of bulk impedimenta on 193 ships of various types during a period of approximately two weeks is a mark of the high degree of success attained in the evacuation of Hungnam. The 2nd Engineer Special Brigade, veteran of 87 Pacific amphibious operations in World War II, of every peacetime amphibious maneuver since, and of the successful amphibious landings at Inchon and Iwon, Korea, during the present campaign, contributed materially to the achievement of this enviable record and once more proved the value and versatility of engineer troops in support of tactical operations.

SMOKE POURED from dock area destroyed by UN forces as they left Hungnam by sea on Christmas Eve 1950, completing two-week evacuation operations assigned to 2nd Engineer Special Brigade.

U. S. Army Photograph

Seabees engineer amphibious landing at Inchon, Korea

JOSEPH F. JELLEY, M. ASCE, Rear Admiral, CEC, USN,
Chief, Bureau of Yards and Docks, Navy Department, Washington, D.C.

SUPPLIES MOVE into Inchon over pontoon pier constructed by Civil Engineer Corps of Navy. Swift tide hampered attempts to erect pier during invasion. Job of securing dock was carried on under continuous enemy fire.

BEHIND the success of the invasion of Inchon last September lay long hours of back-breaking work by the Navy's Seabees. It takes more than guts to move a fighting force across a beachhead. Docks, piers, causeways and other unloading facilities must be constructed, frequently under fire, to bring the supplies and equipment to the fighting front. As early as last June, when most Seabees had not even heard of Inchon, preliminary preparations for an amphibious assault began at the Naval Amphibious Base, Coronado, Calif., where the old 104th Naval Construction Battalion (now Amphibious Battalion No. 1) was engaged in routine duties. Only a few days after the Communist forces attacked the Republic of Korea the Seabees inaugurated a readiness program. Mechanics worked overtime overhauling equipment. Supply men stayed on the job far into the night requisitioning supplies, spare parts and other equipment.

This readiness program averted frenzied activity and wasted effort when the anticipated overseas alert came early in July. The job of preparing for the actual movement continued in much the same manner, with the men working a little harder and a little longer.

For operational purposes, a detachment of 248 men was divided into two companies, a Pontoon Company of four officers and 127 men, and a Construction Company of two officers and 115 men. The Pontoon Company was assigned to operate all pontoon equipment and salvage gear. The Construction Company was assigned to support and reinforce the Pontoon group, set up a central camp and maintain security. While the Construction Company was being equipped and processed for embarkation, the Pontoon Company loaded its equipment and departed for Japan.

On July 13, the Seabees deck-loaded two 3 × 12 self-propelled pontoon barges, with a crew of one chief petty officer and 13 men, on the AKA *Vancey*. Two days later the AKA *Alshain* left with two more barges and a pontoon crew of seven men. LST's 1123 and 1138 were loaded July 26 with two causeways and one warping tug each. The causeways were loaded sidecarry and the tugs were carried on deck. Operating crews accompanied their equipment. The two ships tied up at Port Hueneme to take on additional equipment and set sail for Yokosuka, Japan, on July 28. Two more 2 × 30 causeway sections were loaded sidecarry on LST 845 on August 7, which set sail for Yokosuka bearing all the remaining personnel and equipment of the Pontoon Company.

The Construction Company left August 15 for Kobe, Japan, on the USS *General Wm. M. Weigel*. The vessel also carried elements of the 1st Marine Division. The voyage was no pleasure trip for the men on the three LST's. The ships were buffeted by a typhoon and ran into several minor storms. The crews had to work around the clock to keep causeway lashings secured. Despite precautions, one causeway shifted forward about 50 ft, but none was lost.

En route to Japan, the two AKA's carrying the barges were diverted to Pusan, Korea, where two of the barges were offloaded. Arrangements were made for them to be transferred to the LSD *Ft. Marion*, for transportation to Yokosuka. This was the first unit to reach Japan.

PONTOON BARGES set up by Navy Seabee unit stretch across rugged Green Beach on Wolmi Island. Causeways and barges were brought to island loaded sidecarry on LST's, and were used for round-the-clock movement of troops.

Upon arrival the Seabees immediately began repairing and equipping barges. Three old causeways were salvaged for use in loading and unloading LST's. Pontoon assembly ways and storage yards for supplies and equipment were established, and preparations were made for unloading the material. On August 20 the other two barges arrived at Yokosuka.

Five days later, on August 25, the LST 1138 arrived, and on August 26 the LST 1123 anchored. All hands started working eight hours on, eight hours off, unloading the LST's and beginning construction of pontoon strings on the launching ways.

There was work to be done at Yokosuka, and the Construction Company immediately turned to assembling pontoon strings to be made into docks and causeways. No liberty was granted until the job was completed, at which time the men were given nine-hour passes.

The task of combat loading for the big job ahead followed the brief period of relaxation. Causeways and barges were again loaded, sidecarry, on the LST's. Cranes, bulldozers and other equipment were loaded in the tank decks of the LST's. The warping tugs and new dock sections were made into tows and handled by two ATF's. Operating crews were put aboard the two tugs.

While at Yokosuka, the men constructed two 5 × 30 and one 5 × 15 dock sections, and unloaded and checked all their equipment. The entire unit was combat loaded and under way to the invasion point in eight days. On September 6, the Construction Company boarded the LST Q090, with cranes, dozers and miscellaneous cargo combat-loaded, and headed for Inchon.

Combat ships were bombarding Wolmi Island and the port as the convoy arrived off Inchon. Carrier aircraft fired rockets and dropped bombs to dislodge the enemy from well-prepared positions, and the concussion shook the LST's. The shelling and bombardment continued for hours. A heavy pall of dust and smoke hung over the entire area.

Dock Sections Prepared

On September 15, tows were broken and pontoon dock sections made ready for landing on beaches. A 5 × 30 dock section was anchored off the west side of the island. Because of the tide, which runs at about four knots off Wolmi Island, two attempts failed. The swift tide prevented the use of the section for an LST landing. The dock section was connected to the beach by two 2 × 30 causeway sections and extended 400 ft from the beach. The pier was used immediately for landing troops, vehicles, ammunition and supplies. LSU's, LCVP's and LCM's used the causeway continuously.

The job of securing the causeway and dock was carried on under continuous enemy fire. These causeways were of the utmost importance at Inchon and were in use 24 hours a day. All other beaches were secured about ten hours out of each 24 because of the high tides, which rise 30 ft between ebb and flood. At low tide the main channel into Inchon harbor is no more than a small creek, leaving vast mud flats across which it is impossible to move vehicles.

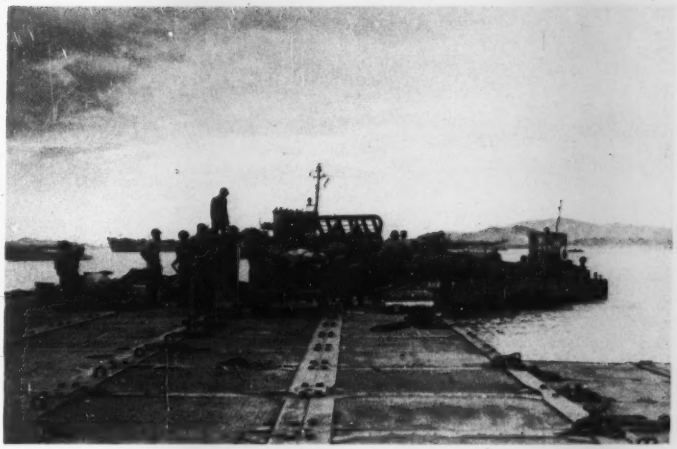
On D plus 1, a dock section was brought into Inchon harbor loaded with a crane to be used as a tide-level landing at "Charley Pier," which was a ramp sloping down into the water. General Douglas MacArthur came ashore across this section on D plus 2.

Camp was set up on Opal Beach directly across from Inchon. The construction men cleared up the debris, leveled a site for the camp, erected 50 tents, a galley, a mess hall and a head in eight hours. Water was the most critical item. It had to be transported five miles in cans by trailers. Chow consisted of "C" rations, seasoned and heated. When flour was available, the Seabees had biscuits, if not, crackers. The first galley burned down, to the dismay of the men, but another was rebuilt in time for the next meal.

A movie projector was obtained and a small outdoor theater was set up. The original plan was to accommodate about a hundred spectators, but by the time the men were ready to leave, attendance had grown to about a thousand marines, soldiers and sailors.

The crew at Green Beach widened the roadway to accommodate three-lane traffic around the west side of Wolmi Island to the Inchon causeway. Warping tugs assisted in salvage operations, clearing the harbor of sunken vessels and raising several small craft.

Six chief petty officers and four men, who had previous experience with steam engines, volunteered to



LCM PULLS INTO pontoon pier constructed by Navy engineers, to unload supplies headed for fighting front during invasion of Inchon. Pier was connected to beach by two 2 × 30-ft causeway sections, and extended 400 ft into harbor.

go to Yong Dong Po, where they recaptured eight railroad locomotives and returned them to Inchon under mortar and sniper fire.

The construction company set up and operated security patrols on Wolmi Island. In addition to maintaining a 24-hour security guard, these patrols buried about 30 bodies of enemy dead and closed 75 caves by blasting.

Carpenters set up range towers and repaired the command post at Charley Pier. Electricians put in temporary wiring. Bulldozers cleared and leveled LST ramps on the inside of Wolmi Island. Cranes were used to load and unload "Ducks" at supply dumps.

Y-Shaped Pontoon Pier Built

On D-plus 4, a pontoon pier in the shape of a "Y" was built on Opal Beach, using five 2 × 30 causeway sections and one 5 × 30 dock section. This was used to unload LST's. One LST, loaded entirely with trucks, was unloaded in 47 minutes.

On September 28, the entire unit was inspected by Rear Admiral J. H. Doyle. Lt. Comdr. M. T. Jacobs, Officer in Charge, was awarded the Bronze Star, and the entire unit received a "Well Done." The same day a fleet recreation area was set up and another area cleared for fleet officers' recreation.

Leaving a small detachment at Inchon for security, the unit was under way again on October 15 for Wonsan, where their LST's were among the first ships to hit the beach. Here the Inchon story was repeated in the offloading of supplies and equipment. However, two operations were added. The Seabees assisted in evacuating casualties over their causeways and in clearing the many tunnels of torpedoes and mines which had been stored there by the enemy. A crew of Seabees was transferred to a repair ship, where they assisted in the repair and maintenance of more than 30 vessels. They were commended for this job by the commanding officer of the repair ship.

The feats of the Seabees at Inchon and Wonsan add another notable chapter to the history of an organization which came into being in World War II. In Korea, they made the most of the opportunity to prove that they are still the "can do" boys, and their permanent role in the Navy is assured.

DIFFERENCE of 30 ft between ebb and flood tide necessitated extension of floating barges far out into water. Barges are shown on beach before they were moved out.

HOOVER DAM—Bid of $48,890,995 won U.S. Bureau of Reclamation contract in April 1931 for Six Companies, Inc., made up of following joint venturers: Utah Construction Co. (sponsor); Pacific Bridge Co.; Kaiser Paving Co., Ltd.; MacDonald & Kahn Co.; Morrison-Knudsen Co.; and J. F. Shea Co.

HUNGRY HORSE DAM—U.S. Bureau of Reclamation awarded $43,431,000 contract in April 1948 to General-Shea-Morrison Co., composed of General Constr. Co. (sponsor); The Shea Co., Morrison-Knudsen Co., Inc.; F. & S. Contracting Co.; J. L. McLaughlin; Pacific Bridge Co.; Walsh Constr. Co.; S. Birch & Sons Constr. Co.; Peter Kiewit Sons' Co.; The Kaiser Co.; J. C. Boespflug Constr. Co.; Gilpin Constr. Co.

J. G. TRIPP, M. ASCE
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Joint-venture contracting—

THE ADVENT of mammoth public works brought with it an entirely new type of contracting procedure. Important projects became too big for individual contractors, so the era of joint-account bidding and construction started. The first joint-venture contract involved six competing construction firms thrown together by necessity and herded into line under one management by powerful bonding company interests—each firm forced temporarily to give up its individualistic attitude and to cooperate with the others on a venture far beyond its own capacity or experience. This coalition succeeded at Hoover Dam and set the pattern for today's major construction projects.

How could this happen? The chief reason is that the successful contractor, although highly individualistic, has a keen sense of values and a part in a big job appeals to his profit motive even at the expense of his independence. The willingness of competitive contractors to pool their trade secrets, as well as their abilities, and to back their combined judgment with real dollars by responsible bidding is a phenomenon not fully understood even by the participants themselves. Contractors are practical men and to them the test of the pudding is in the eating. These characteristics combined with "guts" make it possible for a contractor to act in concert with his next-job competitors. To date, the decreased competition and better management techniques born of joint-venture combinations have made the financial returns attractive—even to rugged individualists. How different this kind of a combination is from a coalition of engineers to design, say, an offshore base for the Navy, for a fixed fee! Reputable engineers do not, or at least should not, bid for work, nor will they make their services contingent on a guaranteed cost for the end product. The contractor does precisely this; hence his different approach to the problems of construction.

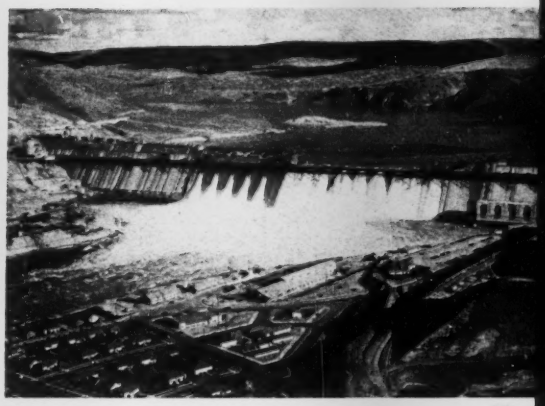
How Bidders Combine

What is the procedure followed in forming a combination of contractors to bid on a project worthy of their joint resources? Most important heavy construction projects start with an engineer's dream—and with talk. During the dream stage the engineer asks his contractor friends for "guesstimates" on this or that feature of his dream structure. Soon a coterie of builders develop an interest in seeing the dream come true. This promotion stage may last for years. Sooner or later local chambers of commerce and congressmen begin to take up the idea and become "fathers" as they visualize the growth and vote possibilities and their names on a bronze plaque—which incidentally often fails to mention the engineer who started it all. Maybe the job will be let by a Reclamation or Army agency. Soon Congress authorizes it, but the appropriation is not yet assured. All along the way, interested contractors start thinking how they can marshall their resources and experience to bid on the proposed work.

To measure their abilities to participate, far-seeing contractors from all parts of the country may take vacation trips to the site and make up tentative estimates of methods and cost. Sooner or later these prospective bidders engage engineering talent to prepare equipment and method surveys so as to increase their knowledge of the best way to attack the job once it reaches the bidding stage.

Discreet calls at the office of the engineer in charge of design bring a knowledge of approximate quantities, and with the help of pre-bid articles in trade magazines or the information service provided by surety companies, a fair picture of the total proposed

SHASTA DAM—U.S.B.R. contract for $35,939,450 went in July 1938 to Pacific Constructors, Inc., consisting of Amer. Pipe & Constr. Co. (co-sponsor); J. C. Maguire & Co. (co-sponsor); The Arundel Corp.; W. E. Callahan Constr. Co.; L. E. Dixon Co.; Foley Bros., Inc.; Griffith Co.; Gunther & Shirley Co.; A. Guthrie & Co., Inc.; Hunkin-Conkey Constr. Co.; L. T. Lawler; Metropolitan Constr. Co.; M. J. Bevanda; Jahn & Bressi Constr. Co.; Clyde W. Wood, Inc.; Shofner, Gordon & Hinman; David W. Thurston.



GRAND COULEE DAM—Final contract for high dam was let by U.S.B.R. in January 1938 for $34,442,240 to Consolidated Builders Inc., made up of Silas Mason Co. (sponsor); Walsh Constr. Co.; Atkinson-Kier Co.; Morrison-Knudsen Co.; J. F. Shea Co.; MacDonald & Kahn Co.; Pacific Bridge Co.; Henry J. Kaiser Co.; Utah Constr. Co.; General Constr. Co.

phenomenon of the construction industry

cost is obtained. The hopeful contractor can now get set to bid on the job.

No contractor, however skilled he may be, is able to get competitive work without the consent of his bonding company and his banker. When a contractor gets bigger than they are he is either too old or too crabbed for successful joint-venturing. The few who have defied this restraint usually have wound up broke—a comment on human relations. So our hopeful bidder begins to sound out his bond and bank connections. Several other contractors do the same, and finally the bond and bank people will suggest that this or that combination of bidders may be possible. One particular contractor, usually the largest or most experienced or best outfitted for the particular type of work, will be suggested as the sponsor.

Now the sponsor will set up a tentative list of partners acceptable to him, with spares in case some drop out. Next, an informal meeting will be held, at which estimated operating capital shares in the proposed bid are meted out and tentatively subscribed. Each member will have spent time and money in the preliminary investigations long before this first discussion and before the job is ready for bids—and probably even before Congress has voted the funds.

During the usual long delays between the various preliminary steps just mentioned, other jobs will have come up and perhaps several members of the original prospective joint venturers will have contracted for other work, with consequent reduction in their several and individual bond and finance capacities for the joint venture. Such firms or individuals either drop out or reduce their initial commitments. Their places are taken by others lower down on the list of firms satisfactory to the sponsor.

Partners Today, Competitors Tomorrow

This shifting goes on usually up to the very night of the letting. Through all this period these individualistic men are learning each others' secrets. They are partners today even though they expect again to be competitors tomorrow. The public service which results from this anomaly in a competitive society is stabilization of bid prices and working conditions for labor, and a higher percentage of successful completions at fair cost to the awarding authorities without loss to banks and bonding companies. It is a system, however, hard for the newcomer to break into.

Finally the date for receiving bids is advertised. The sponsor of our group contacts his list of prospective joint venturers. The capital for bidding is quickly subscribed; arrangements for banking and for the bid bond and the subsequent performance bond are made; a bidding name for the joint venturers is chosen; and then the hard, detailed work of preparing the bid begins. Each component organization is set in motion. Those firms with fully staffed estimating departments tear apart the plans and specifications and begin the tedious process of building an estimate of the cost of the work. Those not so heavily staffed engage one or more consulting construction engineers to do the work for them.

With exchange of information on the sponsor's proposed labor contracts, insurance rates, rentals and acquisition of equipment, and subbids from partners included because of their ability to handle special work, each contractor comes to the prebid meeting with his ideas of methods and equipment, organization and detailed costs and prices on the schedules to be bid. The estimating staffs of the venturers meet and compare their work. There will be as many methods and costs as there are estimators.

The arguments and the give and take at these meetings come from the construction engineers, the superintendents and the estimators. In due course an agreement is reached as to the probable cost of the project.

While this discussion proceeds, the principals of the joint venture argue about the business outlook, inflation, deflation, war, labor efficiency, proposed wage increases, character of union management, strike possibilities, division of responsibility, construction organization and competitive conditions. Through the Associated General Contractors of America, they check on the pulse of Congress, find out what new restrictive laws may be passed during the work term and, most important of all, gage the effect of the next tax bill. They ask each other "Will we bid as a corporation, a partnership, or a joint venture? What margin of profit shall we add to our costs?"

Each contractor comes to the meeting with his idea of a bid. These figures will of course lie in three groups—high, medium, and low. Fiercer arguments will resound over these differences of opinion than over those between the estimators in the other rooms. The unconvinced high man or men may withdraw then and there from the venture and their shares will then be offered to the remaining members or to some firm on the spare list which will be telephoned for acceptance or refusal. Thus the joint venture may be reconstituted.

The venturers then agree on a profit margin and finally accept an agreed cost. The arguments begin to die down and the order is given to close the bid. "What's the competition?" they ask each other. "Shouldn't we leave some items open until just before the letting time?" Finally the bid is sealed and hurried to the letting.

Successful Bidders Recast Construction Plan

The bids are opened and the clerk reads the bid items and prices. To the uninitiated the wide differences in unit prices among the bidding combinations are unintelligible and crazy. Prices may or may not have a direct relation to cost. Plan of attack, knowledge of construction details and financing requirements, tax payment plans, and even forced totals, will have more effect on pricing than the computed costs. Finally the total bids are read and our combination is assumed to be the low bidder. This is the successful culmination of many, many months of planning and scheming—provided the job is actually awarded at this time. Sometimes, of course, all the bids are rejected and another letting is called. Perhaps three bidding combinations will have spent from $100,000 to $200,000 in preparation for this letting. What engineer or engineering concern would spend that kind of money for the privilege of bidding where the odds are two to one against winning.

At last the contract is awarded and the combination gets ready to sign the contract, file the bonds, indemnified as required (as joint, several, or limited), and deposit the capital, appoint the project manager and start the work. All the bidding plans are now thrown away and the project manager organizes his engineering, accounting and field supervision forces and begins the real construction engineering of the job—mobilization of forces, plan of attack, assembly of construction equipment and construction of the camp, administration building, warehouses, railroad spurs, roads, bridges, water and power supply. This work requires experienced technicians and field personnel and the joint venturers keep their fingers on the expenditure of their money (usually 25–30 percent of the total contract price for this preliminary work) through executive, construction, purchasing, engineering, camp and other committees, directing, but for the most part agreeing, with the project manager's decisions.

All these decisions are subject to review and approval by the owner's engineer, a process requiring skill and tact by the parties to the contract. The bigger the job, the bigger the engineer and the wider his experience and that of his staff. Their knowledge and advice sometimes help the contractor to avoid mistakes. While the engineer may be miffed if the contract price is too much above his estimate, he usually is big enough to realize that his foresight as to political and economic conditions may not have been as good as the bidders. If he thinks the bid too low, he may mobilize his staff for close inspection of the job, and may compel too strict conformity with the specifications.

If the bidders and the engineer know each other, the bid price reflects in part the bidders' opinion of the engineer. The fairest engineer will attract the fairest price. The fair engineer not only knows his business but has an understanding of the contractors' problems. He is where he is because he chose that career. The big engineer never feels underpaid for his work in comparison with the contractor who applies his ingenuity, men, materials and takes a big financial risk to lick the construction problem which the engineer and his staff have delineated and which they guide to its final form.

If the job is finished without claims for extra compensation, change orders or disagreement over specifications, offsets for liquidated damages and not too high underruns or overruns in quantities, it is a safe bet that the engineering and administration have been excellent and that the contractor-venturers understood their commitment. To avoid all disagreements is almost impossible, but substantial agreement on basic matters and generally cooperative relations between engineers and contractors yield the desired end result—owner satisfaction with work well done and comfortable profits for those who do it.

Engineer and Contractor Have Different Viewpoints

This discussion of joint venturing gives some idea of the characteristic mental processes of the successful contractor. And it is evident that his viewpoint is different from that of the owner and the engineer. The basic contract assumption that the interests of all three are parallel is valid in direct proportion to the integrity of all three. Actually there are many non-parallel interests arising from the basic differences in viewpoint and characteristics of these three parties involved in the enterprise.

In either public or private work the end product of construction is owner satisfaction. It is assumed that the owner is prepared to pay for value received and is competent to know that value. It is also assumed that he has engaged competent and reputable engineers and architects. This assumption is particularly valid when the contract is with the United States through Army, Navy or Bureau of Reclamation construction agencies.

As for the engineer, it will be generally agreed that the civil engineering profession has high standards of ethics and an enviable performance record. Engineers usually have confident and pleasant business relations with the contracting organizations that execute their plans. However, success in the profession is achieved by personality traits widely different from those which underlie success in the contracting field. Out of these differences arise the conflicts that both bless and curse the construction industry.

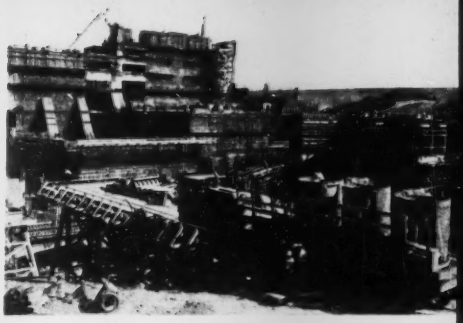
The designing and supervising engineer is usually more of an introvert than the contractor. Most engineers sell their services for salaries or fees. Their work is rewarding and dignified.

The risks they take involve their reputation and professional standing. Success for them is the product of years of study, preparation and codification of experience and research. The contractor, on the other hand, may or may not have an engineering training—or any at all. He generally is an extrovert. He has a knack for handling people, an intuitive feeling for material values. Usually he has worked his way up to an independent position. Above all he has the indefinable characteristic—commonly called "guts"—which draws him into profitable business situations based on risk.

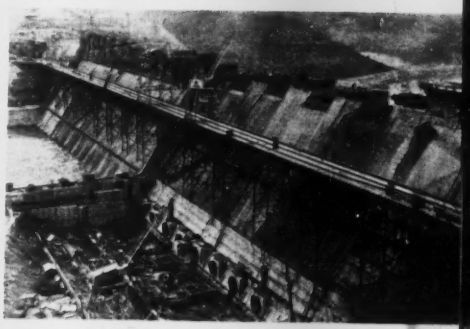
If an engineer makes a bad professional guess he generally has a difficult time regaining the ground he has lost. A contractor on the other hand merely accepts the dollar loss, and even if he is completely ruined financially he can make a comeback without loss of face if he has maintained deep roots of integrity. However, under the present tax structure it is best for the contractor not to go broke. Rebuilding a fortune nowadays is almost impossible. This situation almost offsets "guts" and has a debilitating effect on the risk-taking individualism which has led many contractors to success in spite of many handicaps.

The competent professional engineer usually has done summer work on construction jobs during his schooling years. If he worked for an engineer one summer and for a contractor the next, he soon was able to recognize the differences between the two and choose his course accordingly. After graduation he may have tried contracting and have lost his savings, if not on his first job then on his second or third, with the result that he decided contracting was not his forte. Such an engineer is fortunate for he has discovered that a knowledge of what costs should be is a very different thing from making them come out that way on the job. Probably he wasn't a good buyer, financier, planner, and pusher of men all at the same time.

The engineer risks his hard-won standing but has the training and ability to protect it. The contractor cannot grow without capital and he cannot spend a lifetime getting it. A great engineer, now dead, expressed the idea when he said, "I've worked all my life to build a reputation and financial competence and I wouldn't have the nerve to risk my savings on building this very structure, designed by myself, at a contract price guaranteed and bonded as you contractors do."

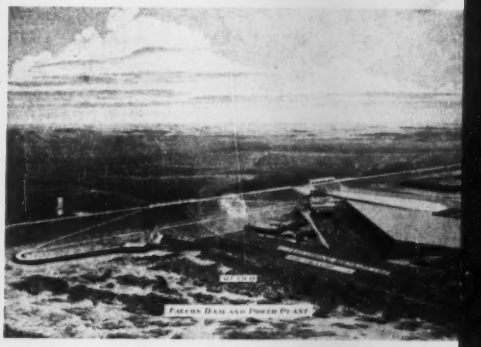


McNARY DAM—Largest single contract yet awarded by Corps of Engineers, for $58,416,459 for third phase of job, was let in April 1951 jointly to Guy F. Atkinson Co. (sponsor); Ostrander Constr. Co.; and J. A. Jones Constr. Co.



BULL SHOALS DAM—Bid of about $20,000,000 won Corps of Engineers contract for Ozark Dam Constructors, composed of Brown & Root, Inc. (sponsor); Wunderlich Contracting Co.; Morrison-Knudsen Co., Inc.; Peter Kiewit Sons' Co.; J. C. Maguire & Co.; Winston Bros. Co.; David G. Gordon; Condon-Cunningham Co.; Chas. H. Tompkins Co.

MOUNT MORRIS DAM—Bid of $20,204,200 was let by Corps of Engineers in spring of 1948 to Mount Morris Dam Builders, consisting of The Arundel Corp., (sponsor); Hunkin-Conkey Constr. Co.; Shofner, Gordon & Hinman; J. C. Maguire & Co.; and L. E. Dixon Co.



FALCON DAM—Two contracts were let in 1950, respectively by U.S. and Mexican Sections of International Boundary and Water Commission, one for part in U.S. ($7,801,064), the other for part in Mexico ($7,922,080). Same joint venturers won both contracts under name of Falcon Dam Constructors in U.S., Constructora Intercontinental S.A. in Mexico. Component firms are C. F. Lytle Co. (sponsor); Foley Bros.; Massman Constr. Co.; Tellepsen Constr. Co.; Edward Peterson Co.; San Ore Constr. Co.; and Amis Constr. Co.

World's largest pumping plant begins Grand Coulee Dam

S. J. BOHMAN, Civil Engineer, Bureau of Reclamation, Coulee Dam, Wash.

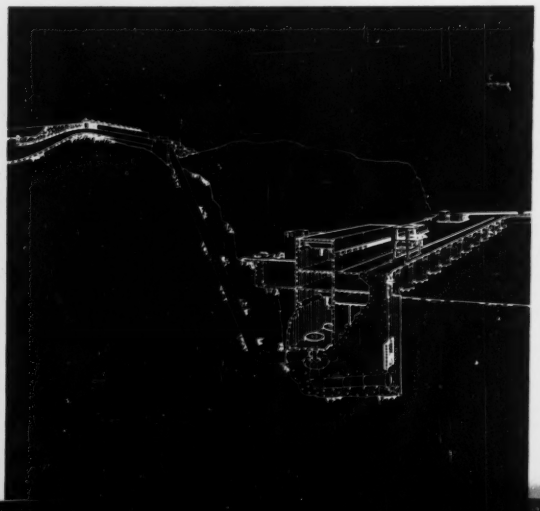
ONE OF the major purposes of Grand Coulee Dam is to store water for pumping up 346 ft into the head of a river-sized canal for the ultimate irrigation of a million acres of land in the Columbia Basin project of the Bureau of Reclamation. Although the dam was started 17 years ago, the pumping plant has just been completed and testing of the first pump was started in May 1951. Grand Coulee Dam stores water not only for irrigation and flood control but also for power. Its two powerhouses can develop nearly 3 million horsepower for pumping and general industrial use.

Construction of the huge pumping station, 615 ft long and 60 ft wide, is the subject of this article. It has been built upstream from the west abutment of the dam in an opening 140 ft deep which was blasted out of solid granite at the time the dam was built. This opening is closed on the reservoir side by the pumping-plant dam. The station will house a battery of 12 centrifugal pumps—the largest ever built—each of 1,600 cfs capacity, driven by a 65,000-hp electric motor, and discharging through a 12-ft penstock extending up through a separate tunnel in the granite west wall of the river. In normal operation the plant will force 16,000 cfs up into the regulating reservoir formed by earth dikes 30 miles apart in the dry gulch of the Grand Coulee. The first two pumps, now being installed, will begin irrigating an initial area of 87,000 acres in the vicinity of Ephrata, Wash., in 1952.

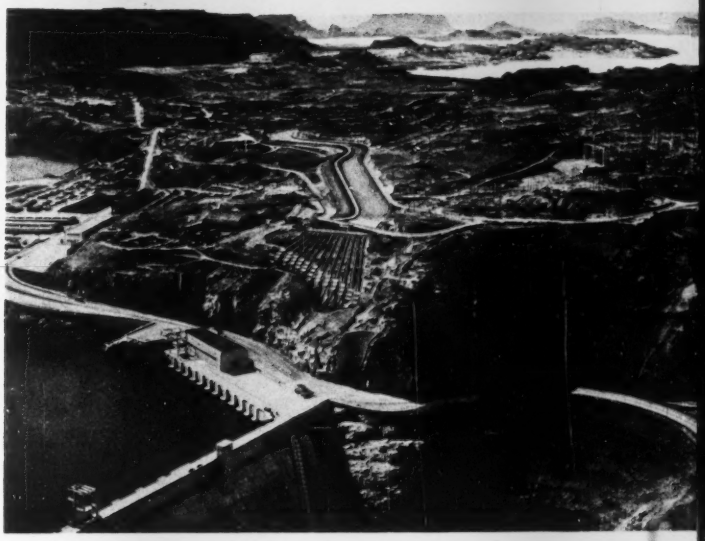
With deep regret the editors announce the sudden death of Mr. Bohman at Coulee Dam, Wash., May 1, 1951.

ONE HUNDRED FEET below deck level, man-made hole behind west abutment of Grand Coulee Dam will house twelve 1,600-cfs pumps—world's largest pumping plant. Each pump is operated by a 65,000-hp motor.

FIG. 1. PUMPS embedded in concrete take water from reservoir behind Grand Coulee Dam through 12-ft-dia suction pipes and lift it about 350 ft, depending on reservoir level, through 12-ft-dia penstocks to main canal.



operation at



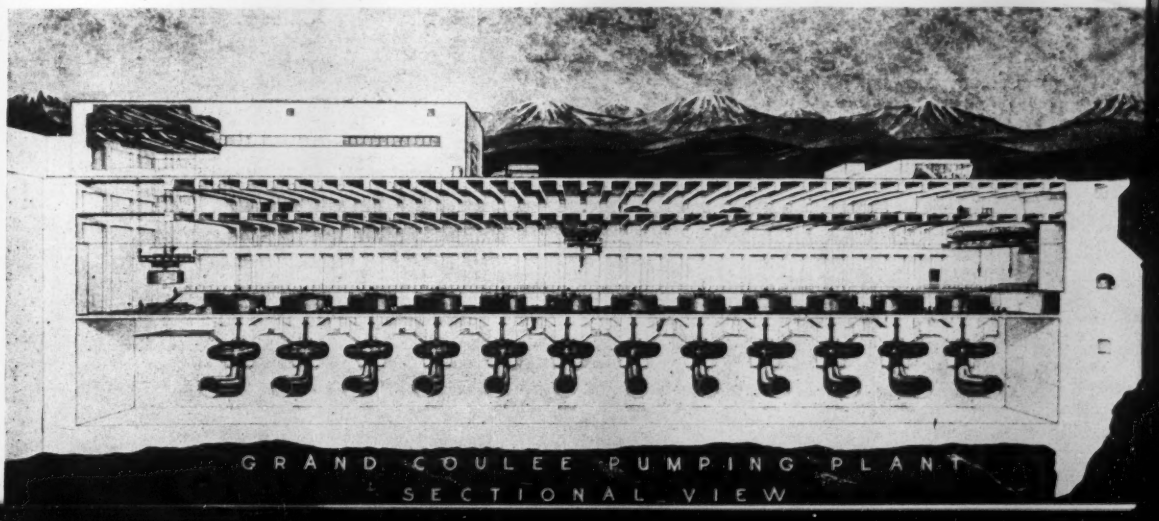
ON AERIAL VIEW, artist has sketched complete pumping-station layout to show twelve penstocks, main 16,000-cfs canal and, in distance, head of 30-mile-long regulating reservoir in Grand Coulee—bed of Columbia River a few million years ago.

WORK of completing the Grand Coulee Pumping Plant was begun in November 1948 by the Morrison-Knudsen Co., Inc., and Peter Kiewit Sons' Co. in a single $13,348,000 contract involving several other structures in the Grand Coulee Dam area. The pumping system included in this contract consists of a pumphouse with space for 12 pumps and motors (Fig. 1), a discharge outlet structure at the entrance to the feeder canal leading to the 30-mile-long balancing reservoir in the Grand Coulee, and a set of 12 plate-steel discharge pipes, each 12 ft in diameter, leading from the pumps to the discharge outlet structure. Each pump is capable of delivering 1,600 cfs of water from Lake Roosevelt behind the dam to the canal 346 ft higher in elevation. Pumping heads will vary from 263 to 363 ft, depending on the level of the lake and the number of pumps in operation.

Located in Man-Made Cavity

The discharge-pipe tunnels were excavated under an earlier contract. In general, the horizontal sections were drilled with a jumbo mounting multiple drills, and blasted material was removed with shovels and bull-

ACCESS TO concrete-embedded pumps is through galleries. Motor room 60 x 600 ft is served by two 100-ton traveling cranes. At left, crane-equipped service bay is open from storage building above deck level so that machinery can be lowered and transferred to motor-room cranes. One pump has been installed and is undergoing preliminary testing, and another is scheduled to be in operation in June. Four more will probably be installed under another contract to be let at a later date. The other six will be added as demand for water on million-acre Columbia Basin Project grows. Floor above pumproom is reserved for parking of employees' autos.



dozers. Various schemes were attempted in the raises to facilitate the simultaneous use of a number of stopes and to provide separate manways and muck chutes to reduce delays in cleaning up and reinstalling equipment after each blast. All material was, of course, allowed to fall to the bottom of the raise and was removed from there.

The section of each pipe ahead of the lower bend, including the bend, was installed from the lower end of the tunnel. The remainder was lowered through the tunnel from the top in sections. The sections were welded after being placed and braced in position, and all welds were radiographed. The pipe within the tunnel was then embedded in concrete and the interior of the entire pipe coated with hot-applied coal-tar enamel. The exterior of exposed portions was painted with aluminum paint.

Construction of the pumphouse presented problems differing from the conventional above-ground construction, since the major part of the building is located in a man-made cavity 140 ft deep, 650 ft long, and increasing in width from 26 ft at the bottom to 157 ft maximum at the top. This cavity was formed by blasting out the granite cliff southward from the west abutment of the main power dam to form a level, rectangular bench 140 ft below the top of the dam. The pumping-plant dam, constructed on the outer edge of this bench, served to withhold the lake water from the cavity. This dam was constructed integrally with, and at an angle of 67 deg to the east-west main dam. The north wall of the cavity was thus formed by the left abutment of Grand Coulee Dam. In this cavity, bounded by excavated cliffs on two sides and by the dams on two sides, working space was limited and construction materials had to be stored elsewhere.

All materials for the major part of the structure had to be lowered into place. The width of the cavity at the top necessitated the use of long-boom cranes. Operating on tracks on top of the pumping-plant dam, two riveted steel, gantry-mounted, electric-powered, self-propelled, revolving cranes met this requirement. Each crane had a rated capacity of 42 tons at a 48-ft radius and a boom length of 95 ft with a 10-ft jib.

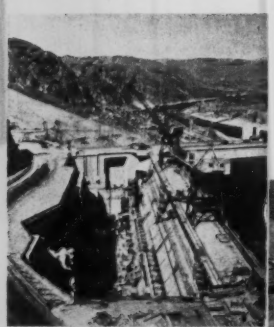
One stiffleg derrick was erected on the upper ground level at the south end of the structure for lowering concrete and materials into the south units and for handling forms and lumber in the adjacent panel yard. A mobile, crawler-type crane, which was operated at the upper bench level on the rock cliff on the west side, handled a part of the close-range work on that side of the building.

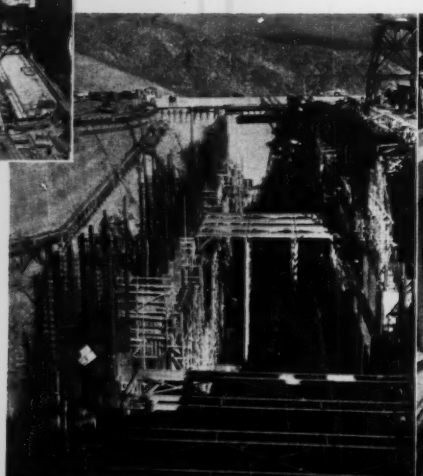
Placement of concrete in the structure called for careful planning so as to avoid interference with other construction operations, such as placing and removing of forms, placing of reinforcing steel, and the installation of a 12-ft-dia discharge pipe in the lower portals of the discharge-pipe tunnels.

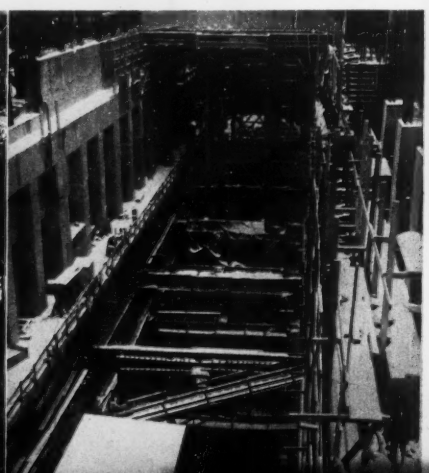
The contractor's procedure in construction was to maintain alternate high and low units, even-numbered units being constructed considerably in advance of the odd units. This was necessary for the placement of tall prefabricated reinforcing units in the wall columns without interference with formwork in adjoining units, as the total thickness of the required formwork was greater than the distance between the reinforcing bars in the adjoining units.

As the building was designed with expansion joints between the 14 consecutive adjoining units, each unit was in a sense a separate structure. When completed, the structure filled and completely decked over the cavity that existed before the contract was started.

The main pumphouse, centered approximately midway between the pumping-plant dam and the rock cliff to the west, consists of two heavily reinforced concrete walls 59 ft center to center, parallel to the pumping-plant dam, with columns along the walls spaced on 15-ft centers. The lower part of the west wall, for a height of 55 ft, was thickened







LOWERING of construction materials into cavity 157 ft wide and 140 ft deep required use of two 42-ton track-mounted revolving cranes operating along top of pumping-plant dam, a fixed stiff-leg derrick, and a mobile crawler crane operating along roadway bench. Steel falsework bents supported girder steel and forms during concrete pouring of motor-room ceiling. Cells in which pumps are to be installed are formed by concrete cross-walls 45 ft apart, forming pits 43 ft long and 55 ft deep.

in a westward direction to fill all space between the wall and the excavated rock cliff on the west. A step on the sloping face of the pumping-plant dam, 55 ft above the bottom of the structure, provided a footing for the east wall.

The 616-ft wedge-shaped opening in the bottom, for a height of 55 ft, was divided into units by cross walls running between the sloping face of the pumping-plant dam and the west wall. The walls, 2 ft thick, were placed in pairs, back to back, at 45-ft intervals. In this way pits 43 ft in length and 55 ft deep were formed, in which pumps and appurtenances are to be installed at a later date. The south unit, 60 ft long, contains no pit. Instead, a mass concrete block 55 ft deep was installed here to serve as a foundation for the erection of pump motors.

The lower ends of the 12 steel discharge pipes, each 12 ft in diameter, were embedded in the lower, mass-concrete portion of the west wall. The pipes are level at this point, and 32 ft above the bottom of the structure.

The two main walls, above the 55-ft pits, extend 85 ft higher, to the top of the dam. There is one reinforced concrete floor at the top level and one 20 ft lower. There are no partition walls between units in this part of the structure. The lower room, 58 ft in height and 555 ft long, serves as the pump-motor room, and the upper is an employees' vehicle parking gallery. The 60-ft erection bay on the south is open to the roof of the storage building, to be described later.

Five Galleries, One Above Another

Lying between the main pumphouse and the sloping face of the pumping-plant dam are five galleries, one above another, which serve as electrical-equipment and bus rooms. These galleries are formed by floors placed monolithic with the main pumphouse and supported by the dam on the east.

The motor room and erection bay are provided with two 100-ton overhead traveling cranes which operate the full length of the building for handling pump and motor parts and electrical equipment. Reinforced concrete brackets, placed monolithic with, and supported by the main wall columns, support the crane rails. The cranes are provided with a lifting beam by which they can operate in tandem.

The east, west, and south walls of the main pumphouse were extended, on the south end of the structure, for a height of 49 ft above the top of the dam, or main structure, to form a storage building 240 ft long with a concrete roof supported by structural steel. A 60-ton overhead traveling crane is provided in this building. The south 60-ft unit of the storage building has no floor; it is open for access of the 60-ton crane loads to the erection-bay floor, where loads can be transferred to the 100-ton cranes for movement into the motor room.

Adjacent to, and west of, the west wall of the pumphouse, a structural-steel-supported, reinforced concrete ramp affords access from the top deck of the plant to the vehicle parking gallery 20 ft below.

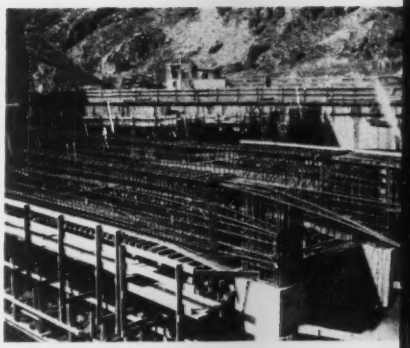
Adjoining the outside of the west wall at the south end of the pumphouse is an office building of reinforced concrete, 55 ft in length and 140 ft high. Of this height, 106 ft lie below the cover deck of the main structure. The office building contains a passenger elevator, stairway, and office rooms for operating personnel.

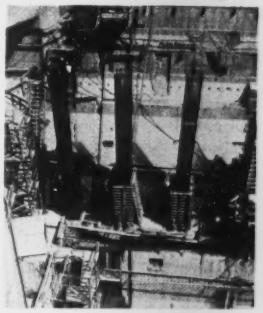
Reception Unit for Tourists

A reception building was constructed at the north end of the structure. Below the main deck this building is 24 ft wide, 45 ft long, and 85 ft high. Above the main deck, it is 46 ft wide, 76 ft long, and 34.5 ft high. A passenger elevator and stairway are provided in the building, which will serve as a reception unit for tourists and include office space for tourist guides when the plant is opened to the public.

The highway that comes in to the dam from the south was blasted from the rock cliff west of the pumping plant. It forms a bench at the level of the top of the dam at the north end of the pumping plant, and increases in elevation on a grade of 6 percent toward the south. A reinforced concrete retaining wall was constructed at the outer edge of this roadway.

The space between the retaining wall and the main pump building is covered by a reinforced concrete deck following the roadway on a 6 percent grade toward the south. The deck was supported on structural steel, which was supported on the west by the retaining wall and on the east by the pumphouse structure. The space south of the main pumphouse was decked in a similar manner to the retaining wall on the south rim. Thus the cavity that existed at the beginning of construction was completely decked over by level or sloping slabs, or by buildings.





STEEL REINFORCEMENT units for girders and columns were prefabricated in yard 3 miles away. In photo at top, reinforcement for main-deck girders is in place on bottom forms ready for setting girder-side and slab forms. Below, column steel in east pumproom wall, to support traveling crane rail, is in place, resting on step on downstream face of pumphouse dam.

Exposed faces of the cliffs below the main cover deck were finished with a 2-ft minimum thickness of unreinforced concrete placed in 5-ft lifts and doweled to the rock.

The heavy reinforced concrete floor of the vehicle gallery above the motor room required a specially designed shoring. The floor system, with a span of 57.5 ft, placed 58 ft above the floor of the motor room, totaled approximately 1,000 tons of dead load for each 45-ft bay. Movable structural-steel bents were placed transversely with the building to support the formwork. The bents were supported on the east and west by the 100-ton crane girders and by steel columns at the third points of the bents, supported on the cross-walls below. The bents, placed 45 ft

center to center, were tied and braced with horizontal and inclined structural steel. On the structural steel, timber decking was placed, and on it timber underpinning to support the floor forms.

Construction of Main Deck

The main deck, at the level of the top of the dam within the pumphouse area, was constructed of the same column, beam-girder, and slab system as the floor below. The same type of forms were used, with timber underpinning supported on the vehicle-gallery floor below. A 5-ply bituminous membrane waterproofing was placed on top of the main deck and covered with a 5-in. concrete cover slab.

Reinforcing steel was fabricated into column and girder units at the assembly yard approximately 3 miles west of the plant, and transported by trucks and trailers to the job and lowered by whirley cranes to the structure. Wall, slab, and beam steel was placed and tied in the structure. A total of approximately 7,500 tons of reinforcing steel was used.

Forms for the under side of girders were set to line and grade and the heavy fabricated reinforcement steel units set. The girder side forms, slab and beam forms, were then completed and the reinforcement laid and tied in place in the slabs and beams. Prefabricated units of column steel were set in place by whirley crane, the wall steel placed, and plywood form panels set up around the steel.

Second-stage concrete was placed in the pump pits in two separate operations. The first operation consisted of placing reinforced concrete in six lifts against the west wall, in which no embedment of pump parts was made. This provided a foundation against which to brace the suction elbow and a level foundation on which piers were placed to support the pump casing. A blockout was provided therein for the installation of the suction elbow.

The second operation in the placing of the second-stage concrete consisted of placing the pump suction elbow, pump casing, and discharge section of pump casing extension, which is connected to the discharge pipe. The installation of hydraulically operated, steel, reverse-flow coaster gates over the inlets on the lake side of the dam made it possible to remove the temporary hemispherical bulkhead at the inside end of the inlet pipe. Then the pump was connected, before embedment, to the inlet pipe from the lake.

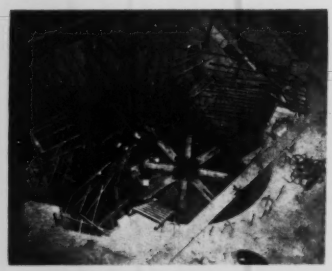
Pumps Embedded in Concrete

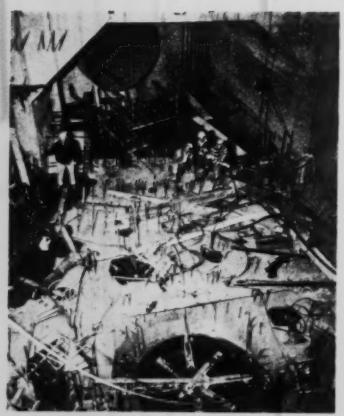
The suction elbow was lowered in sections, the joints welded, and the elbow attached to the inlet by welding. The elbow, thus attached, curves upward for attaching to the under side of the pump. Embedment concrete was then placed around the elbow in four lifts. Pumps and auxiliaries are being installed by Government forces under the supervision of representatives of the Byron-Jackson Co. of Los Angeles and the Pelton Water Wheel Co. of San Francisco, who furnished the two pumps for the current installation under a joint contract. One pump is installed and undergoing preliminary testing, while the other is scheduled to be in operation at an early date.

Pump casing and parts were assembled in place on jacks, and attached to the suction elbow below, and to the 12-ft discharge pipe projecting through the west wall. Reinforcing steel, conduit, embedded metal, and concrete were placed to an additional depth of 16 ft in three lifts. The pits were thus backfilled solid around the pumps and parts to a depth of 37.5 ft, except for small galleries for inspection and access to the inside of the pumps.

The vertical-shaft pumps are guaranteed to deliver 1,350 cfs under a 310-ft head and are expected to deliver 1,600 cfs under the usual pumping head of 280 ft, at the normal speed of 200 rpm. The impellers are 14 ft in diameter.

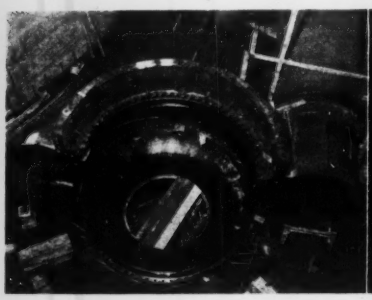
NEAR bottom of pump pits, plate-steel suction elbows were welded to 12-ft inlet pipe through pumping-plant dam.



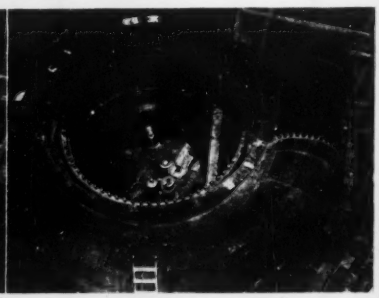


CONCRETE BACKFILL placed around suction elbow becomes foundation on which pump casing is set and attached to elbow in foreground and discharge penstock in background.

LOWER RING of one of 1,600-cfs pumps is in place and half of spiral pump-case is welded to discharge pipe.



SPIRAL PUMP-CASE is completely assembled, ready for placing of embedment concrete.

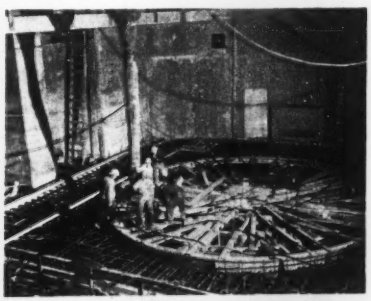


The pump inlets are controlled by 13 x 20-ft reverse-flow coaster gates of the slide type, traveling on stainless-iron endless-chain-type rollers, and are operated by a hydraulic mechanism. In the closed position they can seal on either side, depending on the direction in which pressure is exerted. In this manner they permit unwatering of the inlet pipe and pump casing below lake level or, if the discharge pipe is full, they prevent reversal of flow of such magnitude as to damage the pumps or pipes in case of power failure or other sudden stoppage. The operation of the gates is controlled manually by the operator; there is no automatic feature whereby the gates would operate under specified predetermined conditions.

The motor foundation consists of an octagonal hollow concrete column resting and centered on the concrete in which the pump is embedded. The octagon, 12.4 ft on a side, with a 17-ft-dia hollow center, provides support for the vertical shaft motor and space for the shaft directly connected to the pump. A reinforced concrete floor 48 x 43 ft, 5.5 ft thick, was then placed monolithic with the octagon and supported by steps in the surrounding walls and on the dam. Anchor bolts placed vertically in the floor served to hold the bearing plates of the motor stator. The unit was then ready for installation of the motor by the supplier, and its connection to the pump by Government forces. General Electric Co. furnished the motors for the two pumps in the current installation.

These synchronous motors are rated at 65,000-hp at unity power factor and are 3-phase, 60-cycle, 13,600-volt, 200-rpm machines, attached to the pumps by rigid-flange couplings. They are equipped with amortisseur windings to permit starting as induction motors under reduced voltage if necessary.

EMBEDMENT CONCRETE becomes foundation for pump motor. Circular formwork provides opening for runner and shaft.



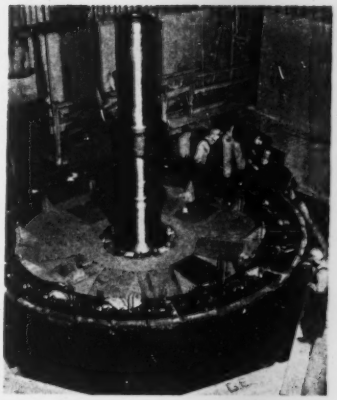
Concrete Placed by Both Pumping and Dumping

Construction of the pumping plant involved the placing of 63,800 cu yd of concrete in the pump building and associated or auxiliary structures, and an additional 2,060 cu yd per pump unit for the embedment of the pumps and construction of motor foundations within the pumping plant. Concrete was placed in the lower 55 ft of the structure in lifts varying in depth from 5.5 ft to 18.5 ft. The main structure above was poured in lifts varying from 6 to 8 ft in height. To lower concrete from the top of the dam, 2- and 4-cu yd bottom-dump buckets were used on the whirley cranes and stiffleg derrick. Concrete was delivered by 4-cu yd dumpcrete trucks from the mixing plant and dumped into holding hoppers at the top of the dam.

The hoppers were discharged into the 2- and 4-cu yd buckets. To deposit concrete in the forms in walls and other confined locations, rubber pipe was used. This pipe was approximately 10 in. in diameter and 20 to 30 ft long. It was clamped to the bottom of a funnel-shaped hopper, which, in turn, was hooked by a quick-change attachment to the bottom of the concrete buckets. Buckets were dumped directly into open pours without using the rubber trunk. A duplex concrete pump was used to deliver concrete for the first operation of second-stage concrete through an 8-in. "quick-joint" pipeline. The pump was placed at the north end of the building and the concrete dumped into chutes leading to the pump below.

For the first 90 days of the contract, concrete was produced at the Government-owned plant on the east side of the river downstream from the dam. This plant consisted of a 2-cu yd tilting-type mixer with a capacity of about 40 cu yd per hour. All concrete in the structure placed after this period was mixed at the contractor-built plant on the west shore of the reservoir about $^3/_4$ mile south of the pumping-plant structure. The plant consisted of two 2-cu yd nontilting mixers with an 8-cu yd receiving hopper. The mixing capacity of the plant was 80 to 90 cu yd per hour.

Concrete aggregates were obtained from storage piles processed under a previous contract from raw aggregates obtained from the Brett deposit northeast of the Grand Coulee Dam. Sand for concrete and sandblasting was obtained from the waste sand pile in the same general location. This pile resulted from the excess in processing aggregates for dam construction.



ROTOR for pump motor is being assembled in erection bay of main pumphouse.

Cement was pumped a distance of $^1/_2$ mile from the storage silos to the contractor's mixing plant by an air-actuated cement pump. Cement was delivered from the rail head at Odair, Wash., about 30 miles from the job site, by the Government-owned branch railroad and by trucking.

For concrete in the structures, $1^1/_2$-in. maximum aggregate was generally used, except in thin walls and confined areas. A water-cement ratio of 0.60 was used in concrete unexposed to outside atmospheric conditions and 0.53 in exposed areas.

Work on the pumping-plant structure under the present contract is now virtually complete.

Designs for the pumping plant were developed in the Bureau's Denver office, and construction was supervised by C. H. Jackson, Resident Engineer for the Bureau. The writer is in charge of office engineering for the work. L. N. McClellan, M. ASCE, is Chief Engineer. Frank Banks, Assoc. M. ASCE, was District Manager of the Columbia Basin Project until his retirement in 1950, when he was succeeded by H. A. Parker.

Contractors' operations were initially supervised by Project Manager A. O. Strandberg, who was followed, in February 1951, by Russell H. Madsen, Assoc. M. ASCE.

Portland engineers survey buildings for air-raid shelter use

R. EVAN KENNEDY, Assoc. M. ASCE
Structural Engineer, Portland, Ore.; President, Structural Engineers Association of Oregon, and Chairman, Survey Committee

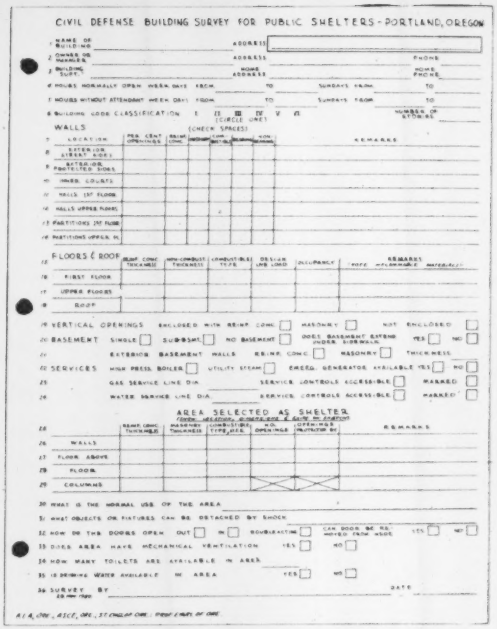

CIVIL DEFENSE BUILDING SURVEY FOR PUBLIC SHELTERS - PORTLAND, OREGON

FIG. 1. EVALUATION SHEET used by Portland engineers in survey of buildings for public shelters records most important structural and other items. Sheet is cross ruled on back for use in sketching out areas selected as "sheltered areas."

MORE THAN 40 percent of the population of the metropolitan city of Portland, Ore., can be accommodated in "sheltered areas" in case of an air raid. This fact was brought out by a structural study of the major buildings of the city, made by architects and engineers. The committee that made the survey consisted of representatives of the Oregon Chapter of the American Institute of Architects, the Oregon Section of ASCE, the Structural Engineers Association of Oregon, the Oregon Chapter of the American Society of Heating and Ventilating Engineers, the City Building Department, and the City Civil Defense Department.

Preliminary committee discussion and investigation soon established the fact that no part of any existing structure in the city could be deemed safe enough to be termed a bomb shelter in the sense that great numbers of people should be directed to it for protection. However, many buildings do have areas within them which would be safer than other areas in case of attack. It was therefore decided to set up a program that would designate an area or areas within existing structures as "sheltered areas." Sufficient room has been found in such areas for about 223,000 people, based on an occupancy of 4 sq ft per person.

The first thing the committee did was to seek a method of evaluating the structures to determine their probable weak and strong points—a method that would produce fairly consistent results when used by various individuals. The result was an evaluation sheet (Fig. 1) listing the most important structural items to be considered, as well as other items a shelter should have, such as water facilities. An instruction sheet was also prepared for use with, and to supplement the evaluation sheet. The final use of the evaluation sheet is as a record of the building's structural features, of the area or areas within it, if any, thought least likely to suffer bombing damage, and of the deficiencies of these areas—which can later be remedied if and when funds are available.

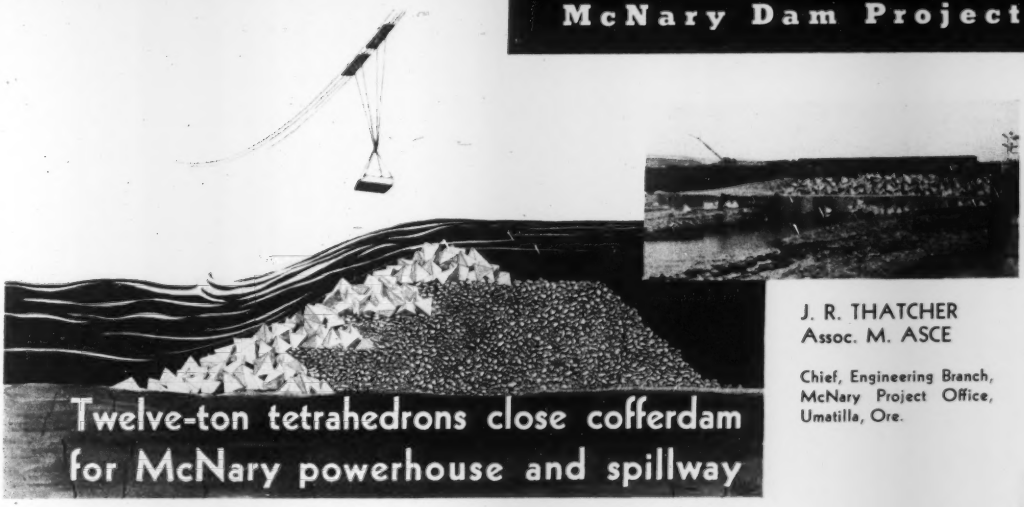
The Building Department had prepared a list of about 104 structures to be examined. To expedite the program, a letter was sent from the office of Mayor Dorothy M. Lee to all members of the ASCE Oregon Section, AIA Oregon Chapter, and Structural Engineers Association of Oregon, asking them to come to City Hall for registration and briefing. The engineers and architects filled the council chambers to overflowing on two occasions.

At the short evening briefing meetings the program was outlined and registrations were taken on cards, which showed the volunteer's preferences as to working time, buildings and areas of the city to be visited. The cards were sorted by the Building Department into like groups, time-wise and area-wise.

Sets of clip boards were next prepared for each group, to cover three specific buildings, with check sheets, cross-section paper, instruction sheets and scratch pads. The volunteers were then called to the Building Department for a second meeting and formed into groups of three as they appeared at City Hall. Each group included both an architect and an engineer whenever possible.

In the buildings, the groups looked for areas that would be protected from flying debris, that would not become flooded or filled with gas, and that would be accessible. The skeleton frame of a building of considerable height can be expected to take quite a bit of punishment. The major killer will be flying debris from filler walls and partitions. No minimum standard was set to which all areas had to be graded. The aim was to find areas that offered a degree of protection greater than that offered by other parts of the same building. There was no hesitation in designating basements as "sheltered areas" when their use seemed warranted by water and gas control. Only buildings of reinforced concrete or steel frame were examined; other types were not deemed satisfactory for protection against a reasonably well placed bomb.

More than 90 percent of the 104 buildings were surveyed in the first two days of the program, and the rest in less than a week. Next, all schools within the city limits were surveyed. The results, in duplicate, were turned over to the city, which is now working out a program of designating the areas specified by the engineers and architects. The building of new air-raid shelters, if any, will be correlated with the analysis of existing structures and population-density information for the most effective use of the money available for air-raid shelters.



Twelve-ton tetrahedrons close cofferdam for McNary powerhouse and spillway

J. R. THATCHER
Assoc. M. ASCE

Chief, Engineering Branch, McNary Project Office, Umatilla, Ore.

THE MOST unusual operation in the entire construction of the McNary project was the closure of the second-stage cofferdam across the main channel of the Columbia River. Here, in a depth of 60 ft of water flowing at a maximum velocity of more than 22 cfs, steel sheetpile cells could not be used because of the overhanging sides of the river bed. Instead, 3,272 concrete tetrahedrons weighing 12 tons each were dropped by cableway, their shape and weight enabling them to resist movement and overturning in the rapidly flowing water. Excellent results were obtained by this probably unprecedented procedure, which will be described in more detail later.

The McNary Lock and Dam, one of the many large multiple-purpose projects under construction by the Corps of Engineers, U. S. Army, is being constructed as an integral unit in the comprehensive program for the development of the Columbia River and its tributaries. The dam structures, containing 1,850,000 cu yd of concrete and 2,100,000 cu yd of earth fill, will extend across the valley a distance of about 7,600 ft. (See next two pages for plan and cross sections, Fig. 1. For location map see Fig. 1 of following article, page 45). The earth fill extends from the bank or bluff on the Washington (north) shore a distance of 1,560 ft to join the concrete structure.

The navigation lock, on the Washington shore, has clear plan dimensions of 86 × 675 ft and a minimum depth of 12 ft over the miter sills. Guard walls, approximately 1,400 ft long, extending both upstream and downstream from the lock chamber, will protect river traffic from the spillway. This lock is the highest single-lift lock in the world, requiring about thirty minutes for the lockage of vessels. One unconventional feature is the use of four Tainter gates in the filling and emptying culverts, with the concave faces of the gates on the pressure side. This positioning of the gates was made as a result of model studies which showed that far less turbulence was experienced during raising and lowering of the gates when they were placed in this manner. To provide access across the lock, a double-leaf bascule bridge has been constructed.

Immediately south of, and adjacent to the lock is the non-overflow section of the dam through which the Washington-shore fishladder passes. The entrances to the fishladder and a fish lock to pass migrating fish upstream are located on the downstream side of this section. The fishladder has a width of 30 ft, a floor slope of 1 vertical to 20 horizontal, and weirs spaced at 20-ft intervals throughout its length.

The spillway extends to the south and will consist of a concrete ogee section, the crest of which will be at El. 291 M.S.L., controlled by 22 two-section, vertical-lift gates 50 ft wide and approximately 53 ft high. The gates will be operated by two 200-ton gantry cranes traveling on the bridge, which is supported by the gate piers. A concrete stilling basin with baffles is provided downstream from the spillway. The lower section of the gates, which are 24 ft 6 in. high, will normally remain seated on the crest of the ogee section, and the upper sections will be raised and lowered to regulate pool level. With all gates removed, the spillway is designed to pass 2,200,000 cfs, practically twice the maximum flood of record.

Another non-overflow section of the dam, located between the spillway and the powerhouse, has an entrance to the Oregon-shore fishladder. This entrance will be controlled by a closed flume along the downstream side of the powerhouse. In addition, there will be a collecting and passage channel extending the full length of the powerhouse and having a total of 87 entrance openings, 44 of them equipped with automatically operated telescopic gates. There will also be an entrance at the south end of the powerhouse.

The powerhouse, located south of the spillway, will house fourteen 70,000-kw generators driven by Kaplan turbines, two station-service generators and an assembly bay.

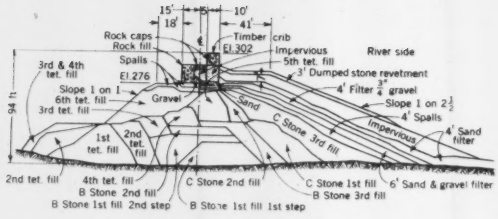
The dam will raise the normal water surface 85 ft and create a pool extending 64 miles upstream. The project includes the relocation or raising above maximum pool level of 86 miles of railroads and 55 miles of highways; construction of five railroad and four highway bridges and three overpass structures; the removal or relocation of miscellaneous telephone and telegraph lines, power lines and county roads; construction of levees in the reservoir area; and acquisition of lands for the project.

The estimated cost of the entire project is $270,000,000.

Several important factors involved in planning the construction schedule were the diversion and care of the river during construction; migration of fish to spawning grounds; minimum interruption to navigation; and the availability of power at the earliest practicable date.

McNary Dam Project

CLOSURE of second-stage cofferdam was accomplished by dumping 12-ton concrete tetrahedrons into 60-ft-deep channel of Columbia River, where unrestricted flow was more than 10 cfs. Overhanging sides of channel prohibited use of steel sheetpiling.



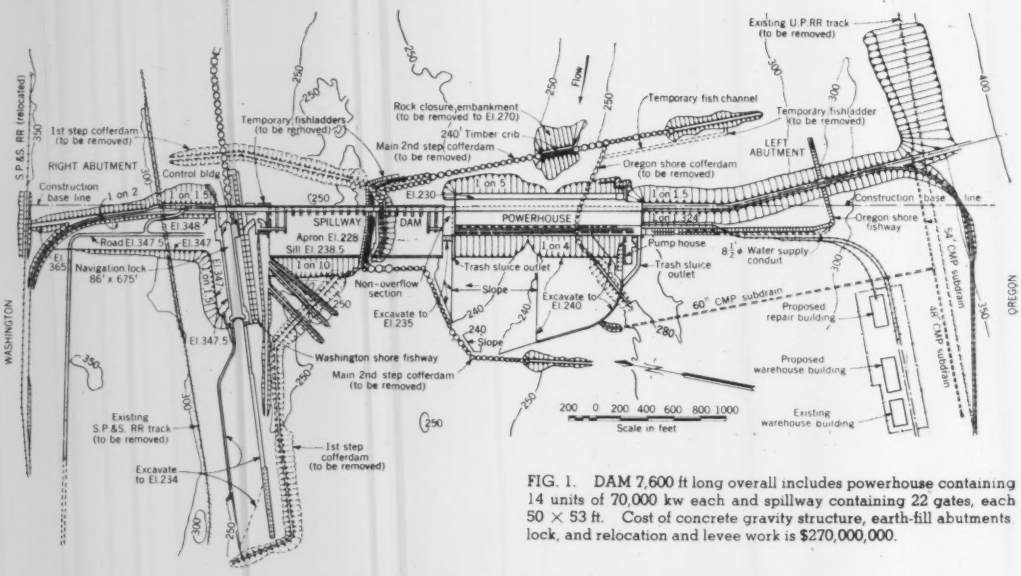
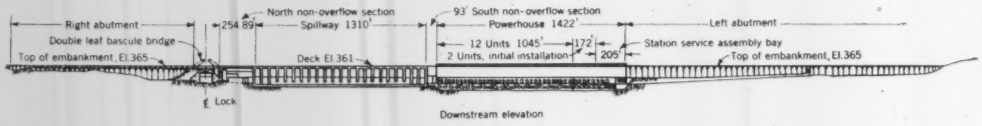
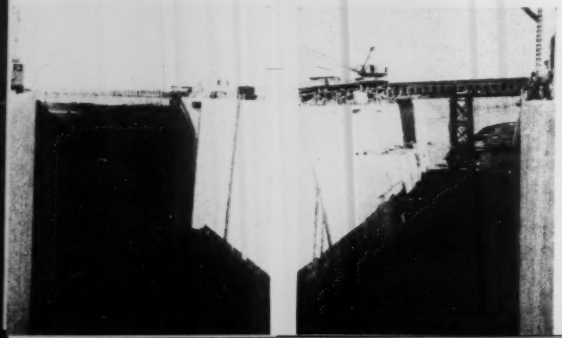
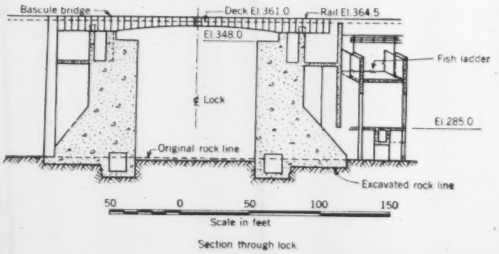


FIG. 1. DAM 7,600 ft long overall includes powerhouse containing 14 units of 70,000 kw each and spillway containing 22 gates, each 50 × 53 ft. Cost of concrete gravity structure, earth-fill abutments, lock, and relocation and levee work is $270,000,000.



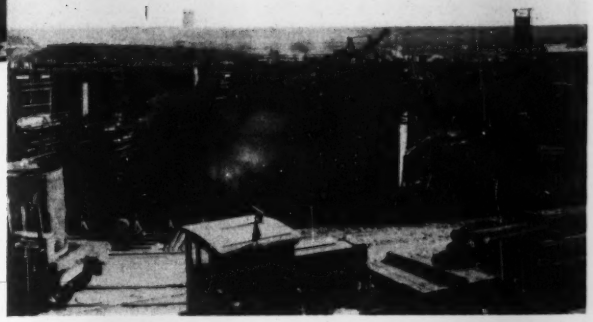
HIGHEST SINGLE-LIFT LOCK in world will raise ships 92 ft at normal pool level. Downstream miter gate (left) is shown completed, while upstream miter gate (right) is temporary construction. Double-leaf bascule provides access across lock.





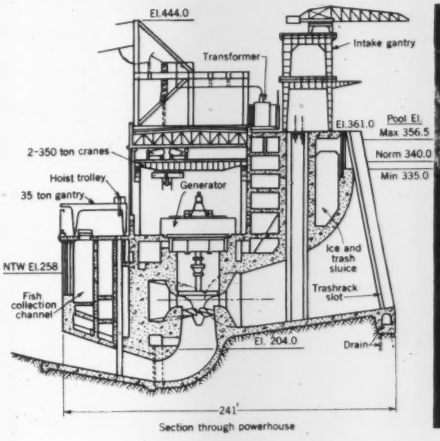
Section through lock

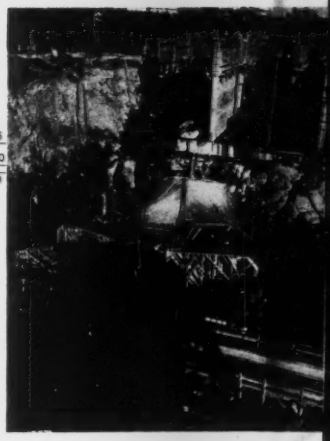
CONSTRUCTION of second-stage cofferdam (left) began after high-water season of 1950 so that closure could be deferred until after fall salmon migration. In background may be seen outer end of third-stage cofferdam, enclosing part of powerhouse. This powerhouse (south end of which is pictured below) will contain fourteen 70,000-kw units, two of which will be made available in December 1953.



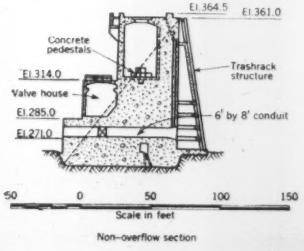
At the site the Columbia has a mean annual flow of 190,000 cfs, varying from an extreme low of 33,000 cfs to the high of record of 1,210,000 cfs (1894). To provide for the passage of the entire flow of the river, construction was divided into three major stages. The first-stage cofferdam, on the Washington side, above the low-water channels, included the navigation lock, the north non-overflow section, the Washington-shore fishladder, and 13½ bays of the spillway. In this stage, to provide for future diversion of the river, the spillway crest was constructed only to El. 250 M.S.L., 41 ft below the final crest. Temporary fishladders were provided through the partially completed spillway bays Nos. 1 and 13. The upstream sill block of the navigation lock was constructed only to El. 260, 58 ft below its final height, to permit the continuance of navigation during the subsequent stages of construction. During the first stage, no interference with navigation or fish was involved.

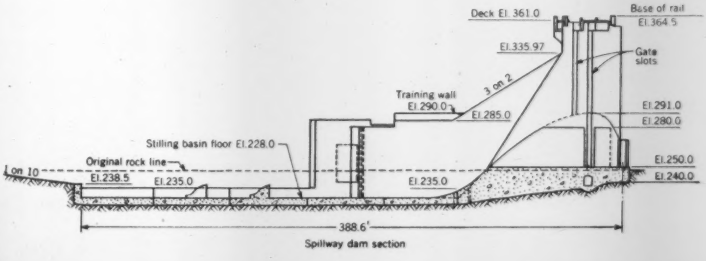
The second stage provided for a cofferdam on the Oregon shore adjacent to the main channel above low water, for construction of the south end of the powerhouse substructure, comprising two main unit bays, station service and assembly bays, and the intake structure for that part of the powerhouse. This part of the second stage was scheduled to begin before completion of the first stage, with the flow of the river restricted





UNIT NO. 2 DRAFT FORM is in place (photo) for early pouring of concrete scrollcase. Turbines will be vertical-shaft, single-runner Kaplan type, with elbow-type draft tube. Runner will have six adjustable blades and will rotate at 85.7 rpm





to the channel south of the first-stage cofferdam and north of the Oregon-shore cofferdam for approximately nine months. The schedule provided for removal of the Washington-shore cofferdam north of spillway bay No. 13 before the high-water season of 1950 and construction of the main second-stage cofferdam after the high-water season. Closure of the river channel would then be deferred until after the fall migration of Chinook salmon, at which time the flow would be diverted through the partially completed spillway bays and navigation routed through the lock. After this diversion the pool level would be maintained at a minimum elevation of 271 to provide a 9-ft upstream approach channel to the lock.

The third and final stage includes the construction of (1) twelve main-unit bays of the powerhouse substructure and intake structures for these bays; (2) the entire powerhouse; (3) the south non-overflow section of the dam; (4) eight and one-half bays of the spillway within the main second-stage cofferdam, raising the ogee section of the previously partially completed spillway bays; (5) completion of the upstream sill block of the navigation lock; (6) completion of the fishladder on the Oregon shore; and (7) completion of embankments on both Washington and Oregon shores. The pool will be raised to its minimum operating level in the spring of 1953 on completion of the ogee crest of the spillway and the sill block of the navigation lock.

As has been noted, two temporary fishladders were provided to permit the migration of fish through the partially completed spillway structure after closure of the low-water channels. In addition to these fishladders, an additional fishladder is provided in the upstream shore leg of the Oregon cofferdam to permit escape of fish trapped by overtopping. Another temporary fishladder is provided through the south non-overflow section of the dam for use after the main second-stage cofferdam is removed and before raising of the pool level to its normal elevation of 340 M.S.L. The two permanent fishladders will be placed in operation on completion of the structure. The cost of all the fishladders is estimated at $15,000,000.

In planning the schedule, it was apparent that navigation would have to be suspended during certain stages of construction. The schedule outlined, limits such suspension to two periods of 90 days each. The first, in the fall of 1950, during closure of the main, second-stage cofferdam, lasted from the time the channel became blocked by construction activities until the pool was raised sufficiently to permit the use of the lock. The second period will come in the spring of 1953, during completion of the upstream sill of the navigation lock, and the raising of the pool to operating level.

So that power can be generated at the earliest practicable date, contracts were placed for the first four units (turbines, generators and appurtenant equipment) in 1948, providing for delivery of complete units early in 1953. Construction of the substructure of the first two main-unit bays during the second stage will permit completion of that part of the powerhouse superstructure and installation of machinery in 1953, making available two 70,000-kw units.

The first stage of construction was accomplished under two major contracts. That for the first-stage cofferdam was awarded to the Guy F. Atkinson Co., South San Francisco, Calif., in October 1947, in the amount of $1,116,610. The second contract, for the construction of a major part of the navigation lock, abutment embankment, and the spillway dam, fishways and appurtenant structures, was awarded to the Guy F. Atkinson Co., Ostrander Construction Co., and J. A. Jones Construction Co., Inc., South San Francisco, Calif., in July 1948, for $21,648,763. This contract involved the placing of 777,500 cu yd of reinforced concrete in the structure, a large part of it temperature controlled to maintain a maximum of 65 deg F during the months of June, July and August, and a maximum of 55 deg F during all other months.

The following additional contracts were awarded for appurtenant work on this part of the dam:

1. Manufacture and delivery of four Tainter valves, liner assembly, bulkheads and trashracks, awarded in July 1949 to the United Engineering Co., San Francisco, Calif., for $122,700.

2. Manufacture and delivery of Tainter valve operating machinery, awarded in September 1949 to the Northwest Marine Iron Works, Portland, Ore., for $72,755.

3. Construction, erection and testing of downstream miter gates and appurtenances, awarded in September 1949, to the Consolidated Western Steel Corp., Los Angeles, Calif., for $641,280.

4. Fabrication and erection of eleven lower spillway gate leaves, lifting beam and appurtenances, awarded in August 1949 to the Willamette Iron and Steel Co., Portland, Ore., for $396,733.

5. Design, manufacture, delivery and erection of two 200-ton gantry cranes, awarded in June 1949 to Judson Pacific-Murphy Corp., Emeryville, Calif., for $459,830.

6. Design, manufacture, delivery, erection and testing of two stoplog derricks, awarded in August 1949 to the Washington Iron Works, Inc., Seattle, Wash., for $116,580.

7. Installation of electrical items in the lock and dam on the Washington shore, awarded in May 1950 to Michieli's Electric, Hermiston, Ore., for $193,320.

8. Construction of a double-leaf bascule bridge across the navigation lock, awarded in December 1949 to the Willamette Iron and Steel Co., Portland, Ore., for $419,839.

9. Furnishing, installation, and testing of three electric service elevators for the Washington shore portion of McNary Lock and Dam, awarded in May 1950 to Montgomery Elevator Co., Moline, Ill., for $37,977.

10. Miscellaneous items of equipment required for this part of the work.

In April 1950, the upstream and downstream legs of the first-stage cofferdam were removed and the riverward leg to the south of the crib cofferdam was partially removed. The remainder was left in place as a swimway to an emergency entrance to the Bay 13 fishladder. All work on this stage under the major contract was practically completed when the main second-stage cofferdam was closed.

Second Stage Started in 1949

The second stage of construction was initiated in August 1949, under a contract awarded to the Guy F. Atkinson Co., Ostrander Construction Co., and J. A. Jones Construction Co., Inc., for $15,835,539. This work included the Oregon-shore cofferdam; the concrete substructure for two main units; a station-service and an assembly bay for the powerhouse; the main second-stage cofferdam; and a part of the Oregon-shore abutment embankment.

The closure of the upstream leg of the second-stage cofferdam across the main channel of the river was probably unprecedented in construction history, considering all the circumstances. The river channel is 60 ft deep at this point, the velocity of flow in the unrestricted channel exceeds 10 cfs, and the river bed is a dense basalt rock. The sides of the river bed were overhanging at several

points, precluding the use of steel sheetpile cells, which were used in the remainder of the cofferdam. Closure was scheduled to begin on October 10, 1950, because a river flow of about 100,000 cfs could be expected and the fall run of chinook salmon would have passed the dam site. Before that date, the contractor erected a cableway across the channel. The cableway had both a movable head-tower located upstream on the Oregon shore and a movable tail-tower located downstream on the island north of the channel.

The initial operation was the placement of 12-ton concrete tetrahedrons, selected because of their shape, which makes them extremely resistant to movement and overturning in high water velocities. These tetrahedrons were placed in the downstream toe and slope in a series of horizontal lifts. For each lift the tetrahedrons were placed first, then the lift was extended upstream with 1- to 5-ton stone. This operation was repeated, lift by lift, until the downstream part of the closure fill was well above the water surface. The more impervious upstream part of the fill was then placed. A total of 3,272 tetrahedrons were cast and placed in the fill. During this operation, river flows of 140,000 cfs and velocities as high as 22 cfs were experienced.

On completion of the closure fill, a timber crib, 30 ft wide and connected to the cells at both ends, was constructed and the downstream leg of the cofferdam was completed in slack water.

The McNary power plant, one of the larger ones in the country, will have an installed capacity of 980,000 kw. It will consist of fourteen 70,000-kw units, capable of providing for peak loads of 1,127,000 kw.

The main turbines will have a rated output of 111,300 hp at 80-ft head and will be designed to operate at heads ranging from 62 to 92 ft. They will be of the vertical-shaft, single-runner, Kaplan type, with concrete scroll-cases and elbow-type draft tubes. The runner will have six adjustable blades and rotate at 85.7 rpm. The estimated shipping weight of each turbine is 2,202,000 lb, and each turbine runner and shaft will weigh 345 tons.

The contract for the first four turbines was awarded in June 1948 to the S. Morgan Smith Co., York, Penn., for $5,031,567. A contract for four additional turbines was awarded in January 1950 to the same firm for $4,974,090. The remaining six units will be advertised for bids later.

The main generators will have a rated capacity of 70,000 kw and will be capable of operating at a continuous overload of 15 percent, or 80,500 kw, without exceeding 80 deg C rise in the windings. Generator voltage will be 13,800 v. These generators, among the largest in the world, will have rotors 36 ft in diameter, weighing 600 tons. The generator thrust bearing will have a load of approximately 4,250,000 lb, including the hydraulic thrust on the turbine blades.

A contract for the first four generators was awarded in December 1948 to the General Electric Co. for $7,304,674. A contract for four additional units was awarded in March 1950 to the same firm at $6,483,220.

The McNary Lock and Dam project is being constructed under the supervision of the Walla Walla District, North Pacific Division, Corps of Engineers. Brig. Gen. O. E. Walsh is Division Engineer; Col. W. H. Mills is District Engineer; and S. G. Neff is Resident Engineer in charge of construction. Power-plant design is under the supervision of R. C. Schuknecht, North Pacific Division, and the design of all other structures is under the supervision of J. E. Reeves, M. ASCE, Chief of the Engineering Division, Walla Walla District.

Unstable talus slopes complicate 86-mile railway relocation

RAYMOND R. GARNETT, Assoc. M. ASCE

In Charge of Relocations, Construction Division, Walla Walla District, Corps of Engineers, Walla Walla, Ore.

RELOCATION of railways and highways through hard columnar basalt and unstable talus slopes along the banks of the Columbia River is rapidly approaching completion. This relocation, made necessary by the backing up of the river behind McNary Dam, has been further complicated by the narrowness of the construction area and the necessity of maintaining traffic during the work.

Grading on three contracts is now completed and work is in progress on surfacing of highways and laying of ballast and track, installing signal systems and restringing telephone and telegraph lines. This work affects the main line of the Spokane, Portland & Seattle Railway, on the right bank of the Columbia River, and the Umatilla-Spokane main line of the Union Pacific and U. S. Highway 395-730 on the left bank. (See map, Fig. 1.)

Completion of this first phase of relocation of highways and railroads in the reservoir area is necessary before the 1951 floods come because of the final closure of the Oregon-shore cofferdam at McNary last November. After closure a flow of 530,000 cfs will reach the S. P. & S. tracks at the dam, and 700,000 cfs will flood the Union Pacific tracks at a low point

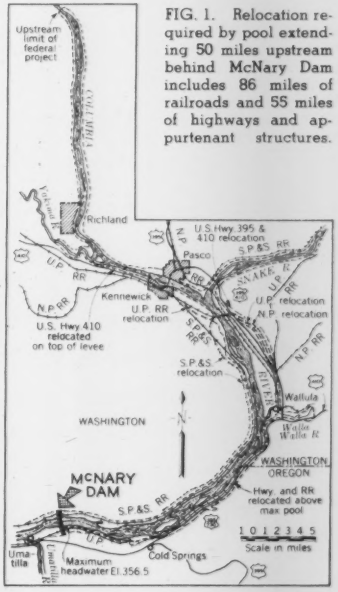


FIG. 1. Relocation required by pool extending 50 miles upstream behind McNary Dam includes 86 miles of railroads and 55 miles of highways and appurtenant structures.

in the grade about 15 miles above the dam. The 1948 and 1950 floods reached 980,000 cfs and 719,000 cfs respectively at McNary, and the 1894 flood has been estimated at 1,200,000 cfs at McNary. The necessity of providing higher embankments for railroads and highways before the 1951 flood season is readily apparent.

During major floods the influence of McNary Dam on Columbia River backwater elevations will extend about 50 miles upstream to the vicinity of Richland, Wash. The upper half of the reservoir above Wallula Gap will lie in a relatively flat basin that is highly developed and will require protection by levees. The gorge downstream from Wallula Gap is about a mile in width and has been cut by the river through a high plateau of volcanic origin. The bluffs now rise from 600 to 1,000 ft above the river. Main traffic routes have followed the river through the Wallula Gap since the days of the Lewis and Clark expedition.

Construction now being completed on the right bank of the river involves 35 miles of Spokane, Portland & Seattle track, starting 7 miles below McNary Dam. The new subgrade reaches El. 351 at the dam, 52 ft higher than its present line, and rises an additional 2.7 ft in easy stages to the existing grade near Finley, Wash. After this section is completed, the only work remaining on the S. P. & S. Railway is to raise the grade near Finley, and along the right bank of the Snake River near its mouth.

On the left side of the river, the Union Pacific Railroad and U. S. Highway 395-730 are now being relocated for a distance of 22 miles upstream from McNary, to the point where the Walla Walla River joins the Columbia. The railroad company is completing new switching yards at Hinkle, Ore., and 13 miles of new line from Hinkle northeast to the Columbia near Sand, Ore. This work is part of a plan approved by the Interstate Commerce Commission and sponsored by the railroad company. It includes vacating the existing yards at Wallula, Wash., to be under 15 ft of water when the reservoir reaches normal pool level at El. 340, building new yards at Hinkle, connecting the Hinkle yards to the relocated line near Sand, and vacating the existing line from Sand to Umatilla and from Irrigon to Messner, all in Oregon. The Government is obligated only for the cost of relocating the Umatilla-Sand line and the Wallula yards. Instead of this relocation, however, the Government will pay the railroad an equivalent sum toward the cost of the new Hinkle yards and the Hinkle-Sand line.

Between Sand and the Walla Walla River, the Government has completed, by contract, the relocation of 11 miles of Union Pacific and 11 miles of highway, including bridges and section facilities. A crossover at Port Kelley, Wash., where the existing grade rises to the level of the relocated grade, will permit trains to operate over both the new line from Hinkle to Port Kelley and the old line to Wallula and beyond until the construction north of the Walla Walla River is completed.

Existing Trackage Simplified

The maze of existing trackage in the Wallula-Burbank area will be simplified considerably by the relocation now planned. It appears feasible to provide 5.8 miles of Union Pacific track, 5.4 miles of Northern Pacific track, and 10.5 miles of joint track in lieu of the 15.9 miles of Union Pacific and 16.5 miles of Northern Pacific main-line and branch track now in use. However, final agreement on this plan has not been reached by the parties concerned. This part of the project is scheduled for construction in 1951 and 1952.

Other work upstream from the present construction includes relocation of parts of the highway from Wallula Junction to the Snake River and of the Kennewick-Richland portion of U. S. Highway 410. A highway bridge and a Union Pacific Rail-

NEW SUBGRADE for Spokane, Portland & Seattle Railway tracks (left) is 52 ft higher than old line (right). Relocation rises 2.7 ft more to existing grade near Finley, Wash.

EMBANKMENTS for Oregon State Highway and Union Pacific Railroad run parallel at mouth of Juniper Canyon. Partially completed piers and abutments for railroad bridge can be seen in foreground, with existing highway bridge immediately behind.

IN CANYON SECTIONS, rock blasted from cliff was cast by shovels to river side of S. P. & S. tracks. This was only practicable method where cliffs overhung railroad.

road bridge will be built at higher elevations to replace the existing bridges across the Walla Walla River. The Washington Highway Department is building a new bridge across the Snake River to replace the one that burned in the fall of 1949. The Government is contributing what would have been spent to alter the approaches of the old bridge outside the limits of ordinary high water.

U. S. Highway 395-710 has been closed to traffic since March 1950. The Washington Highway Department has widened and reconstructed State Highway 8 across the Horse Heaven Hills between Kennewick and Plymouth so that it can carry the increased traffic through the relocation area. The Government will reimburse the state up to $200,000 for this cost.

Final agreement is pending concerning the action that will be taken in regard to the Union Pacific Railroad bridge across the Columbia River and the Northern Pacific Railway bridges across the Snake and Columbia Rivers. Levees will be built to protect Pasco, Kennewick, and Richland, and the south approach of the Pasco-Kennewick highway bridge will be raised to accommodate the Kennewick levee.

The total expenditure for the reservoir relocation program, not including levees, is estimated at $34,000,000. All together the project consists of: Relocation or raising of 86 miles of railroad; rebuilding or reconstruction of 55 miles of highway; new construction of four highway bridges, five railroad bridges, and three overpass structures; and removal or relocation of miscellaneous telephone and telegraph lines, power lines, and county roads, as well as the action pending in regard to the three railroad bridges across the Columbia and Snake Rivers.

The recently completed construction was started in January 1950, and all work was scheduled to permit operation of trains on the relocated grades in May 1951. The S. P. & S. Railway started operations on the new track on May 12, and the Union Pacific was scheduled to start on May 27. Construction operations were particularly difficult because of the rugged terrain through the gorge below Wallula Gap and the necessity of operating trains throughout the construction period. The fact that only very few minor traffic accidents occurred is an indication of the care exercised by the contractors in keeping the tracks clear.

The most difficult part of the work was in the gorge, confined for the most part to a narrow strip between the river and sheer rock bluffs and talus slopes. The new alignments alternately pass through rock cuts in the sides of the bluffs and over flat, low-lying areas and the face of high talus slopes. The rock cuts were faced to 4 on 1 slopes through basalt formations as high as 180 ft above the new grades.

In many places on the S. P. & S. relocation, the talus deposits extend to the edge of the railroad on slopes as steep as 1 on 1.3, and the railroad is crowded on a narrow shelf between the talus slope and the river. The talus slopes that were disturbed in the construction were graded to 1 on $1^1/_2$. The severely restricted construction space along the talus slopes left the contractors, Morrison-Knudsen Co., Inc., and Gibbons & Reed Co., little choice of working methods. Talus material was removed by shovel from the toe of the slope directly beside the tracks to form a narrow space for storing materials that later raveled down the slope. Bulldozers then pioneered their way to the top of the slope to push material over the edge of the berm there. The contractors alternately removed material from the bottom of the slopes and dozed material from the top until the slopes were dressed to the required grade. The travel of the material down the slope from the dozing operations along the berm served to dislodge material above the reach of the shovel and reduced the danger of an excessively surcharged slope.

This work was extremely hazardous during the early stages because of the danger that boulders would be "triggered" by the vibration of passing trains and would roll down onto the tracks. To reduce this hazard the contractors on the right bank removed precariously balanced boulders from the slope by barring them down by hand. In addition to these precautions, in some places a ridge was placed alongside the tracks, or a ditch was dug lower than grade to form a basin to catch boulders at the bottom of the slope.

On the left bank there was much more working space for highway and railroad relocation. Besides using the method followed on the other side of the river for working the talus slopes, the Utah Construction Co. was able to rig up a slack-line cable from a logging winch installed on a tractor to a wide drag with heavy spike teeth. The upper end of the slack-line cable was anchored to the bluff

UNSATISFACTORY SILT and ash is excavated from subgrade of roadbed for Union Pacific relocation. Rock and gravel were used for refilling to grade.

STRATA of loose volcanic ash, having densities as low as 54 lb per cu ft, were frequently encountered. In flood of 1948, low fill on sloping silt and ash dropped 3 ft. Here such a deposit is being excavated before reconstruction of U. P. RR roadbed.

IMPROVISED equipment loads borrow for U. P. roadbed from pit on gravel island in Columbia River. Grading specifications require rail embankment to consist of rock, gravel or talus, with not more than 20 percent passing 1/2-in. screen, except where fines (minus 1/2 in.) are clean, sound particles essentially free of fine sand, silt or ash, with not more than 45 percent passing 1/2-in. screen.

along the pioneer road at the top of the talus slope and was moved along the pioneer road by a tractor, from one anchor to another, as needed. Movement of the lower tractor parallel to the toe of the slope permitted full coverage of the drag over the face of the slope and enabled large amounts of material to be dragged down at each position of the cable. This material was removed by shovels and trucks.

Foundation conditions through the relocation areas were found to vary widely, but the materials could be divided into four general classifications—solid rock, talus slopes, alluvial deposits, and eolian or wind-blown deposits. The rock is generally sound basalt varying in structure from columnar, which breaks up into blocks of 1 cu ft or larger, to fractured basalt which will break into fragments generally 8 in. or less in size. The talus slopes, derived from weathering of the high basalt bluffs, are relatively clean rock except for pockets of fine sand, silt, and ash deposited by the wind. The rock and talus material were excellent for foundations and embankments except when more than 40 percent is fine-grained material. The alluvial sands and gravels also were considered satisfactory.

The major problem in the design of the embankments was the effect of submergence on the stability of the unconsolidated alluvial and wind-deposited silts and fine sands, which vary in thickness from a few feet to 40 ft or more. Well-defined strata of loose volcanic ash were frequently encountered, and mixtures of ash and silt were also common. Ash materials with densities as low as 54 lb per cu ft were encountered.

The unusually high stage of the 1948 flood provided an opportunity to study the effect of submergence on the stability of the wind-deposited and other fine-grained soils throughout the relocation areas. After the flood had subsided, it was found that the existing railway track had settled from 1 to 6 in. or more in at least 14 locations in a 25-mile length. At a number of locations the embankment shoulders dropped as much as 12 in. The affected sections ranged in length from 50 ft to as much as 1,500 ft. On the Union Pacific Railroad a low fill on sloping silt and ash foundation dropped 3 ft. Embankments that showed subsidence were invariably founded on low-lying, wind-deposited materials which came in contact with the flood waters. As far as could be determined, subsidence was due mainly to consolidation and partial shear failure of the saturated materials.

The crest of the 1948 flood was only 6 to 8 ft higher than that of previous floods experienced by the railroads, whereas the reservoir at normal pool level, El. 340, will completely submerge the foundations of most of the relocated lines. It was therefore evident that serious settlements would result if the embankments were placed on these loosely compacted materials.

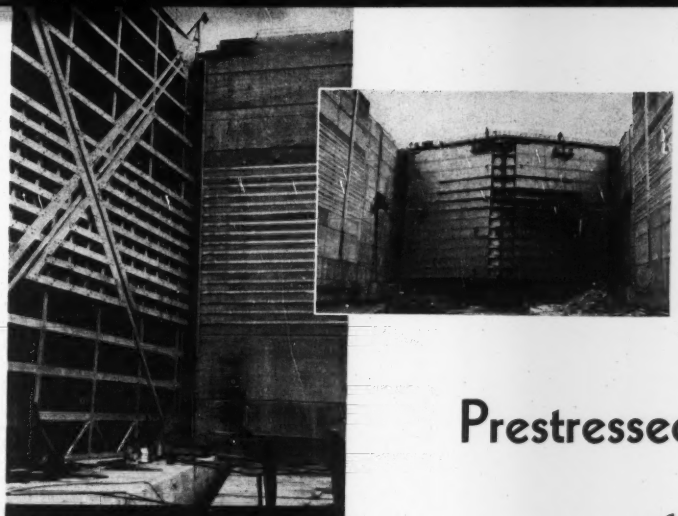
A number of approaches to the design suggested themselves, and there was considerable contradictory opinion as to the most economical plan. The only method, however, that eliminated the probability of excessive settlement was the removal of potentially unstable soils and their replacement with rock, gravel, or other coarse, granular material, and construction of the embankments with such materials. This plan was finally adopted, except that all materials below an elevation 3 ft above the water table at a river discharge of 200,000 cfs were considered to form a satisfactory foundation. It was felt that such materials are normally saturated, will consolidate appreciably during construction and are generally confined, thus minimizing the possibility of trouble after the line is completed.

The highway embankment is constructed of random materials and is located on the land side of the Union Pacific embankment. Since the proximity of the railroad fill to the highway—generally 70 ft between center line—affords ample protection against shear failure and erosion, foundation excavation was not considered necessary.

The grading specifications require that railroad embankment materials shall consist of rock, gravel, or talus of which not more than 20 percent passes the 1/2-in. screen, except where the fines (minus 1/2 in.) are clean, sound particles essentially free of fine sand, silt or ash, with not more than 45 percent passing the 1/2-in. screen. This specification permits the use of talus materials provided silty fines are not present in sufficient quantity to prevent point-to-point contact between granular particles.

The presence of the talus slopes and the alternating flat, low-lying areas made it economically feasible to improve the alignments of both railroads. The talus slopes generally projected toward the river from the high bluffs, and the excavation and embankment quantities were fairly well balanced by placing the alignments through the talus deposits and using the excavated talus materials in the embankments across the low areas. In the 35 miles of the S. P. & S. relocation, the total central angle of curvature was reduced from 538° 52′ to 446° 32′ 30″, a cut of 17 percent. Similarly, the Union Pacific total central angle was cut from 581° 09′ to 462° 03′ 30″, a drop of 20 percent.

Relocation of railroads and highways for the McNary Dam project is under the supervision of the Walla Walla District, Corps of Engineers. The District Engineer is Col. W. H. Mills, who succeeded Col. William Whipple, M. ASCE, in July 1950. Carl H. Heinke was in charge of design under the supervision of James E. Reeves, M. ASCE, Chief of the Engineering Division. Leo M. Buhr is Chief of the Construction Division, in which the writer is in charge of relocations, with George J. Schoch the Resident Engineer on the right bank, and Joseph F. Skidmore on the left bank.



DIAGONAL CROSS-BRACES, prestressed to counteract torsional deflection, double stiffness of gate leaves in Chain of Rocks Lock, now under construction near St. Louis in Mississippi River.

CARL L. SHERMER

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Prestressed cross-bracing stiffens lock gates

THE WORD *prestressed* probably is associated with the word *concrete* in the minds of most engineers. However, at the Chain of Rocks Lock now under construction in the Mississippi River, as well as at a number of other navigation locks, prestressed cross-bracing has been used successfully to stiffen steel miter gates.

A lock-gate leaf is relatively high and wide compared with its thickness. For instance, each leaf of the lower gates in the main lock at Chain of Rocks is 70 ft high and 61 ft wide but only $4\frac{1}{2}$ ft thick. Hence there is always the problem of providing sufficient stiffness against warping or twisting of the leaves as they are swung through the water. The usual method of providing this torsional stiffness is to put cross-bracing on the leaves.

The cross-bracing is ordinarily made adjustable with sleeve nuts or turnbuckles so that the leaves themselves can be adjusted properly to meet or "miter" at the center of the lock. Proper mitering of the gate is important not only for appearance and watertightness, but also so that the thrust transmitted from one leaf to the other when they are closed (and are supporting a head of water) does not have excessive eccentricity.

It might seem at first glance that when a leaf is hanging in the open position, the diagonal braces carry vertical shear in much the same way that the diagonals of a truss do. As a matter of fact, until recently this was always the assumption used in their design, and still is in some offices. The real function of diagonal members, however, is to prevent twisting of the leaf by resisting the torsional shearing deformation which tends to occur in the open face. When a leaf twists, the open face becomes a parallelogram with one diagonal increasing in length and the other decreasing. Whether a particular diagonal increases or decreases in length depends on the direction in which the leaf is twisted. The diagonals usually are eye-bars and can take tension only. Therefore, on an unprestressed leaf, one diagonal resists torsion of the leaf in one direction and the other diagonal resists torsion in the opposite direction.

A torsional analysis of lock gates makes it possible not only to predict the amount of the torsional deflection, but also to prestress the diagonals so as to minimize that deflection. Just as prestressed concrete can take tensile stresses up to the amount of the initial compressive prestress, so a prestressed tension tie can take compression up to the amount of the tensile prestress. Therefore, by prestressing the tension cross-braces on the lock gates, the braces are made effective in resisting either tension or compression, and the stiffness of the leaves is doubled. In addition to stiffening the gates, prestressing eliminates the little annoyances which always result from loose diagonals.

The method of prestressing a gate leaf is simple. The leaf is twisted in one direction to throw a predetermined amount of slack into one diagonal. This slack is then removed by taking up the adjusting nut. Then the leaf is forced in the opposite direction, again by a predetermined amount, and the slack introduced thereby into the other diagonal is taken out. Thus, when the leaf is released and returns to its normal position, each of the diagonal members is stretched back to its normal length and has a definite amount of prestress. At the time the slack is removed from a diagonal, the twist of the leaf is greater than the computed torsional deflection expected during operation, so that at no time during operation will either diagonal become slack. During prestressing, the leaf is twisted easily by holding it against the lock wall at the top and jacking it out at the bottom, or vice versa.

The torsional analysis and prestressing technique here described were developed by the writer in the office of the U. S. Engineers, Upper Mississippi Valley Division, St. Louis, Mo., and in the graduate school, Civil Engineering Department, University of Michigan. A complete treatment of the subject is available in book form from the writer.

Photos are by Corps of Engineers, Upper Mississippi Valley Division.

ENGINEERS' NOTEBOOK

Buttress-type dam with curved upstream face proposed

HORACE P. BOARDMAN, M. ASCE

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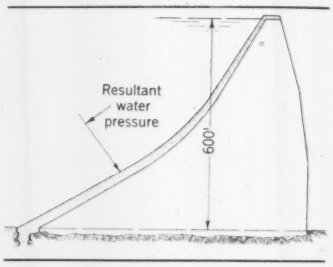

FIG. 1. PROPOSED buttress-type dam has upstream face curved so that slope is 60 deg at top and 30 deg at bottom.

WHY NOT build dams that will cooperate with the water instead of defying its pressure? Perhaps a better way to put it might be—build dams that will compel the water to cooperate with the structure to insure its stability. The type of buttress dam shown in the accompanying sketch, Fig. 1, would utilize a resultant water pressure with a vertical component greater than its horizontal component, thus causing the water to cooperate with the weight of the dam to hold it in place.

The straight or long-radius curved gravity type of dam presents a nearly vertical surface to the water of the reservoir. Thus a large mass of masonry is required so that its weight combining with the horizontal water pressure, will bring the resultant pressure on the foundation within safe bounds. Also, the broad base of the gravity dam invites, and in many cases receives, upward water pressure thus necessitating additional mass to insure stability.

The true arch dam, and particularly the constant-angle arch dam, built in a suitable location proves conclusively that great mass is not necessary to withstand water pressure even in the case of high dams. Sloping timber dams supported by rock-filled cribs or by timber bents have been used for a long time, probably for several centuries, their upstream surfaces usually having a slope of between 15 and 40 deg. Modern hollow reinforced concrete buttress dams with sloping upstream slabs merely substitute a different material for the timber used in the old-style structures. However, these modern slab dams have generally been built with an upstream slope steeper than 45 deg, thus supporting a water pressure with a greater horizontal than vertical component. Likewise the hollow, multiple-arch buttress dam generally has an upstream slope steeper than 45 deg.

These reinforced-concrete hollow buttress dams of both the slab and the multiple-arch types have proved very successful during the past fifty years in general, and what failures have occurred have probably never been chargeable to the type.

Very severe climatic conditions have caused trouble with thin reinforced concrete sections but sudden failures of such dams, in practically all cases, have been due to undercutting or penetration of water past the cutoff wall.

Lack of an effective cutoff wall is probably one of the most common causes of failure of dams other than those of the earth or rock-fill types. The poor quality of the foundation rock under the St. Francis Dam, which failed in Southern California, should no doubt have prevented the selection of that site even if the construction of an effective cutoff wall had been possible.

The cooperative dam here advocated, when built on a good rock foundation, need have no difficulty from upward pressure since the buttress footings would not cover the whole natural rock surface under the dam. As an additional safeguard, holes several inches in diameter could be drilled near the edges of the buttress footings, and slanting under these footings to any desired depth. Such holes could be backfilled with gravel or crushed rock. Whatever water might penetrate beyond the cutoff wall would escape by these holes without developing dangerous upward pressure under the cutoff-wall footings. In some cases grouting of the bedrock through drill holes beyond the bottom of the cutoff wall is of course advisable.

When a high dam of this type is constructed across a canyon of trapezoidal cross section, the lower part of the dam, near the ends, can be either of the same vertical curved type or merely an extension of the upper part of the high central section. In any case the same care should be exercised in providing an effective cutoff wall as is followed for the high central section of the structure.

In high dams of this type, the use of structural steel shapes, either riveted or welded, for the reinforcing in the buttress walls would afford convenient attachment for concrete forms for both the buttress walls and the under surface of the slab. If preferred, multiple arches between the buttress walls could be used in place of the curved slab. I do not favor extremely thin sections such as have often been used for reinforced concrete buttress dams of both slab and multiple-arch types—with the reinforcing steel very close to the exposed surfaces of the concrete.

Even with relatively heavier construction than that suggested above, this cooperative type of dam should be much lower in cost than the massive gravity type in spite of the higher cost per cubic yard of concrete. An article by me advocating this type of dam was published in the May 25, 1929, issue of *Western Construction News*, page 270.

Observations verify graph for water used by growing trees

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AMONG the basic tools of engineering are empirical graphs and formulas. The practicing engineer must continually check the results secured through the use of these tools, not only to retain his confidence in them, but also to make needed modifications as new information comes to light.

It is often desirable to know the depth of water used by growing trees, in addition to the evaporation loss from the leaves of the trees and from the bare soil or cover crops surrounding the trees. These evaporation losses are in addition to the water used by the trees, and the two together constitute evapo-transpiration, or consumptive use. A useful tool for determining transpiration is the Meyer Base Curve which I developed over 25 years ago and first published in the ASCE TRANSACTIONS for 1915 (Vol. 79, p. 1094).

A measure of the accuracy of this curve may be obtained by comparing transpiration values derived from it with the results of actual observations recorded in Bulletin No. 686 of the University of California Agricultural Experiment Station at Berkeley, published in March 1944. The ground in an orchard of citrus fruit trees was mulched to prevent evaporation, and irrigation water was applied through furrows. The transpiration loss was determined by frequent soil sampling for moisture. In Table I, I have tabulated only the average observed values and have added the values computed from the base curve for comparison.

Evidently the transpiration values read from the base curve, even without the application of any coefficient, are close enough for practical use on trees of medium size, in fair condition. Available moisture, as well as type and density of vegetal cover, must of course be considered in all estimates of transpiration loss. Such factors as these can be expressed as a coefficient to be applied to the base-curve values.

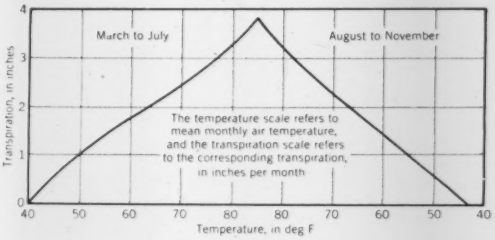

FIG. 1. Base Curve of Transpiration is empirical graph which constitutes one of tools of engineering. Curve is reproduced from paper by the writer, "Computing Runoff from Rainfall and Other Physical Data," ASCE Transactions, Vol. 79 (1915), p. 1094.

TABLE I. OBSERVED TRANSPIRATION IN INCHES OF DEPTH OVER TWO ORCHARD AREAS

Compared with values obtained from Meyer's Base Curve of Transpiration, Fig. 1.

Test Locations and Months	Observed Transpiration, In.			Transpiration from Base Curve, In.	Mean Temperature*
Coastal Zone, Orange County:	Older vigorous trees	Younger trees	Average		
April	1.3	1.3	1.3	1.6	59.2
May	1.9	1.5	1.7	1.9	62.7
June	2.7	1.7	2.2	2.2	67.0
July	3.1	1.9	2.5	2.5	71.0
August	2.9	1.9	2.4	2.4	71.2
September	2.4	1.7	2.05	2.1	68.6
October	1.7	1.3	1.5	1.7	63.8
Totals	16.0	11.3	13.65	14.4	

	Observed Transpiration, In.		Transpiration from Base Curve, In.	Mean Temperature†
Interior Zone, Riverside and San Bernardino Counties:	Excellent and good trees	Fair trees		
April	2.0	1.4	1.7	60.0
May	2.6	2.1	2.0	64.1
June	3.0	2.6	2.4	70.2
July	3.8	3.2	2.9	76.0
August	3.6	3.2	2.8	75.9
September	3.0	2.4	2.2	70.7
October	2.6	1.8	1.8	64.7
Totals	20.6	16.6	15.8	

* At Santa Anna, in degrees Fahrenheit. † At San Bernardino and Riverside, in degrees Fahrenheit.

THE READERS WRITE

New Deformed Reinforcing Bars

TO THE EDITOR: The article by C. A. Willson in the March issue (p. 34) states:

Usually hooks can be eliminated since better deformations provide improved anchorage.

That is a dangerous doctrine, not supported by data. It is based on misunderstanding of both the bond action of deformed bars and the mechanics of reinforced concrete. Long-radius end hooks are cheap insurance against the sudden collapse of a member that is subject to high bond stresses, and are features of good design, whether plain or deformed bars are used. The article states also:

The study of bond in steel reinforcing bars goes back to 1906. . . .

It goes back much farther than that. Thaddeus Hyatt published tests of bond between concrete and iron bars in London in 1877. By 1906 there was an extensive literature on this subject.

Reference is made to the 238-page Bulletin 71, University of Illinois Engineering Experiment Station, of which the writer is the author. It records bond tests that were made in 1909 on seven commercial deformed bars and on one special bar. After considering the effects of height and spacing of projections and the relations of bond, shearing and bearing stresses in concrete, this conclusion was stated:

> A bar with projections extending around the circumference, practically perpendicular to the axis and having a height of, say, $^1/_{10}$ of the diameter of the bar and spaced, say, $^1/_2$ the diameter apart, would answer the requirements mentioned above. (p. 80)

The 1950 ASTM specifications require for the six largest bars, "Min. Height" of projections, 0.05 diameter. Practical problems of rolling-mill operation would demand 0.07 or more. Compare with 0.10 in Bulletin 71. The specifications require "Max. Avg. Spacing" of 0.7 diameter. Manufacturers would select 0.6, or less. Compare with 0.5 in Bulletin 71.

The Bulletin 71 "specification" for improved deformed bars:

1. Anticipated Mr. Willson's conclusion that "less expensive pull-out tests can give reliable measure of bond."
2. Indicated that improved deformed bars would be round.
3. Recognized that the ratio of height and spacing of projections to bar diameter was the only basis for a deformed bar of scientific design.
4. Pointed to "projections extending around the circumference."
5. Pointed to projections "practically perpendicular to the axis."
6. Gave projection heights that differ only slightly from those now used.
7. Gave spacings that differ 0.1 in., or less, from those now used.

In other words, the "fine cooperation among government agencies, technical societies and producers," referred to by the author, plus the expenditure of $600,000, has solved again a technical problem that was solved at the University of Illinois 42 years ago.

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New York, N. Y.

Concrete Damp-Cured for Three Days Develops Only Fraction of Its Potential Strength

TO THE EDITOR: The paper, "There Is No Substitute for Brains—Use Them," by Clyde W. Wood, in your April issue (p. 30) contains these statements:

> Curing time of concrete has received a lot of study, but in spite of the fact that it was definitely established in the 1920's that little or no hydration takes place after the first 72 hours, much money is still being spent on curing for 7 to 14 days. I recently was required to hold forms on a 15-ft arch for 14 days, which meant that my form costs were triple those actually needed to provide an equally good structure.

My researches lead to entirely different conclusions. In 1917 I studied dozens of groups of tests of concrete strength made in the U.S.A. and in Europe. Without exception the strength of damp-cured concrete was still continuing at the last test age, which ranged from 3 months to 9 years. (*Proceedings*, American Society for Testing Materials, 1918, Part II).

The above report developed the "law of cement hydration":

$$S = a + b \log d$$

where

S = unit strength of concrete
d = age at test, days
a, b = constants for a given set of tests, values depending on type of strength test, characteristics of cement, and water-cement ratio

The increase in strength is a direct function of the logarithm of the age. For usual damp-cured concrete, strength will follow that law until all cement is hydrated, which may require many years or centuries. In this equation a measures the early strength (theoretically it is the 1-day strength); b measures the rate of increase in strength.

Subsequent data show that the above law holds for compressive tests up to 30 years, and that the same law applies also to other measures of hydration, such as heat of hydration and fixed water. Data released 6 years ago show that interior temperatures at Hoover Dam had not reached a maximum, although the concrete was then $11^1/_2$ years old. (Closure by C. Rawhouser, *Proceedings*, American Concrete Institute, 1945, pp. 348–21.)

In 1918, I showed that at 120 days concrete cylinders damp-cured for the entire period gave compressive strengths of the following ratios, as compared with similar concrete damp-cured for 3 days only:

Water-Cement Ratio		Strength Ratio
By vol.	Gal per sack	
0.65	4.2	1.8
0.73	5.5	1.7
0.81	6.0	2.0
0.91	6.7	2.2
0.99	7.4	2.8
1.09	8.1	3.0

Additional curing was relatively more effective in wet mixes than in dry (Masonry Committee Report, *Proceedings*, American Railway Engineering Association, 1919).

Concrete damp-cured for three days develops only one-fifth to one-third of its potential strength. That shows how much is sacrificed by limiting curing to three days, as advocated by Mr. Wood. Much of the inferior concrete so often seen in arid regions is attributable to too much mixing water plus inadequate curing. Here minimum curing should be 28 days; if the hot months are encountered, curing should be continued for 60 to 90 days. Each additional day pays big dividends in avoiding shrinkage stresses, cracks and crazing.

DUFF A. ABRAMS, M. ASCE
New York, N. Y.

Many Airfields Still Satisfactory for Military Operations

TO THE EDITOR: In reference to the article in the April issue of CIVIL ENGINEERING, "Modern Military Aircraft Change Airfield Design Concepts," by General Newman and me, I would like to add the following comments.

It was not meant to imply in the article that progress in aeronautical design has made all military airfields obsolete. This is only true in the case of certain airfields where heavy loads and high contact pressures have necessitated reconstructing or reinforcing of existing pavements. Many installations are still satisfactory for military operations.

On page 35, Fig. 2, the 50[k] curve on the left is for 100 psi, not 150 psi as indicated. In the second paragraph under "Runway Lengths," on page 38, only the ground-run characteristics of aircraft are found in the handbooks, *Flight Operating Instructions*, which are published for each aircraft. The safety factors and a detailed description of the USAF method of determining runway lengths were published subsequent to the preparation of the article. (USAF Regulation 86-5, prepared by M. Weinroth, M. ASCE.)

I should also like to express my appreciation to the individuals who assisted in the preparation of the material on which the article is based: Prof. S. J. Buchanan, M. ASCE, Texas A. & M. College, for Fig. 2; T. B. Pringle, M. ASCE, Office, Chief of Engineers, for Fig. 5 and other data; J. L. Mills of my office for collection of data and drafting; and Dr. F. L. Meara, M. ASCE, of my office for editorial assistance.

H. E. BROWN, Lt. Col., CE
Command & General Staff College
Ft. Leavenworth, Kans.

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L.E. Gurley, America's Oldest Engineering Instrument Maker

Niagara's Mysteries Solved

The first accurate survey of the Niagara River bed, from its source at Lake Erie to a point below Niagara Falls, has been completed by the Buffalo District, U. S. Army Corps of Engineers. Basis for a scale model (1-360) of the Falls and River, built at Vicksburg, Miss., for study of remedial work on the Falls, the profile employed almost every known sounding method—and several brand-new ones.

Surveying the Upper Rapids above the crest of the Falls, where current runs 15 to 20 mph, was the major hazard. Earlier efforts to chart these waters proved inaccurate; and many suggestions were discarded before the Engineers thought of using a "flying platform."

Flying over the spot to be sounded, a Bell helicopter reeled out 1500 to 2000 feet of steel wire line through pulleys. An orange pennant, attached 30 feet above a saucer-shaped lead weight, was the target. The helicopter dropped straight down until the weight hit the bottom of the river. Line slackened, and then was pulled taut by a light counterweight. The pilot radioed, "Target!", to four ground watching parties, who shot the pennant on their transits; obtained information for computing elevations. As many as 77 readings were made in one day, with the helicopter flying back and forth in paths 300 feet apart.

Kytoons (helium-filled balloons) were also used where the channel was narrow or high trees lined the shore; and for finding elevation from the crest of the Falls to the waters below. Two kytoons, 8 feet long, 4 feet wide, were lashed together, with a third riding above the center. This gave enough lift to support a weighted sounding line, threaded through a pulley on the underside of the kytoon. One man maneuvered the captive kytoons; another manipulated the sounding line. Transitmen, signaled by walkie-talkie, placed the weight at the exact spot on the river bottom.

Gurley on the Team

"This survey was made possible by good teamwork," says Everett Becker, Civil Engineer attached to the Corps of Engineers. "I've been using Gurleys ever since I learned to use a transit; was glad to have Gurley on the team."

You may never have to chart the floor of a river or measure the height of Niagara Falls. But you, too, will find a Gurley Transit a valuable member of *your* surveying team. Bulletin 50 gives all details.

SURVEYORS: Send in an unusual field experience for this series. We also welcome your comments and suggestions.

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SOCIETY NEWS

West Coast Sections Study Local Problems in Regional Conferences

Society and Section affairs and technical problems of special concern to Western engineers were emphasized on the agendas of two recent West Coast Regional Conferences—the third annual meeting of the Pacific Northwest Conference in Portland, April 27 and 28, and the fourth annual conference of California Sections in Yosemite National Park, May 3 to 5.

Pacific Northwest Conference

National officers speaking on ASCE affairs at the Pacific Northwest Conference were President Gail A. Hathaway, Vice-President Fred C. Scobey, and Director Walter J. Ryan. Discussing his recent trip to the international engineering conferences in India, Mr. Hathaway urged the concern of engineers for such matters as engineering conditions abroad, the allocation of our funds for foreign construction projects, and the handling of the Point IV Program. Mr. Ryan headed a discussion of civil defense, with members from Portland, Seattle, and Spokane outlining the situation in those cities where the Local Sections have been active in the defense program. A motion that the Conference act as a coordinating agency or clearing house on problems involving civil defense was carried.

In a Local Section Forum considerable study was given the topic of better integration of Junior Members and students into Local Section activities. To strengthen cooperation with the Student Chapters, a resolution inviting the Pacific Northwest Conference to coordinate its 1952 meeting with the regional conference of Local Sections was adopted.

The technical program included talks by R. R. Clark, chief of design for the Portland District of the Corps of Engineers, who described the results of a long series of tests for cavitation effects on the concrete at Bonneville Dam; Colonel Lipscomb, of the North Pacific Division, who outlined plans for the Pacific Northwest, including construction of a navigable channel from the Pacific up the Columbia to a point above Lewiston, Idaho; and Past-President J. C. Stevens, Portland consultant, who discussed "The National Water Policy." Of wide general interest was a talk by James E. Travis, assistant manager of the Atomic Energy Commission, Hanford Works, Wash., and observer at Bikini. Outlining a basis for structural design to resist atomic bomb damage, Mr. Travis stated that structures can be designed to withstand a blast not closer than half a mile. At Nagasaki, a reinforced concrete building remained with the structural frame intact at that distance from the explosion. He recommended a wind load of 90 lb per sq ft horizontally and 70 lb vertically.

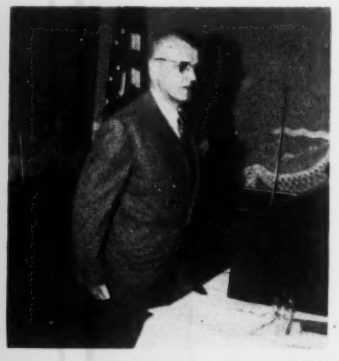
The group accepted an invitation from the Columbia Section to hold the 1952 annual conference in Richland or Walla Walla, the time and place to be decided by the Section. Officers for the 1952 conference will be Guy H. Taylor, chairman; J. E. Travis, vice-chairman; and H. Loren Thompson, secretary-treasurer.

California Conference

More than 400 attended the three-day California Conference, sponsored jointly by the Sacramento and San Francisco Sections. Several phases of Society and Section business were discussed in an afternoon session. R. R. Rowe, of the Sacramento Section, pointed out discrepancies in boundaries of some of the Districts and Zones, and R. D. Dewell, secretary of the Sacramento Section, suggested streamlining collection of Local Section dues. Other subjects included in the business discussion were operation of technical activities committees at Local Section level, the California Legislative Council, and unionization of engineers. ASCE President Gail A. Hathaway and Executive Secretary William N. Carey were among Society officers present to speak on ASCE affairs.

A high light of the convention was the annual Student Chapter Conference attended by delegates from eight colleges in the area. Winners in the annual student paper competition were Edwin E. Pyatt, of California Institute of Technology, who won first prize for a paper on "Radioactive Tracers in Hydraulic Studies"; Richard A. Lovell, of the University of California, second prize; and Michael Degleys, of the University of Southern California, third prize. The University of Santa Clara Chapter was host to the group.

California water problems were discussed on the technical program by S. T. Harding, ASCE Director and consulting engineer of Berkeley. There is enough water in the state to meet future needs,



PORTLAND'S WOMAN MAYOR, the Hon. Dorothy Lee, is on hand to welcome the Pacific Northwest Conference. She is shown here with ASCE President Gail A. Hathaway. Featured speaker James E. Travis, of Atomic Energy Commission, is pictured at right. Small view above shows Thomas H. Campbell, conference chairman.

FEATURED technical speakers at California Conference are S. T. Harding (upper left), Neil Petree (right), and N. A. Bowers.

he asserted, "provided we can afford to control it and convey it where we want to use it." Stating that problems of design and construction have been solved to an extent that makes its safe to assume any water project can be designed and built, Mr. Harding termed the matter of costs "the greatest single problem in the future extension of our water development." It is his opinion that needed projects justify expenditures required to build them.

Another problem of special local interest was dealt with by Neil Petree, vice-president of the California State Chamber of Commerce and chairman of its Highway Committee, in a paper entitled "Highway Modernization." He stressed the fact that a paramount issue facing the state is the problem of obtaining additional revenues for state highway construction and reviewed possible methods of financing.

In a paper called "Engineering Failures," Nathan A. Bowers, who recently retired as Pacific Coast editor of *Engineering News-Record*, called attention to the importance of such failures when they result in improved design. "They establish the limits of safe design as nothing else can," he declared, citing as a case in point the "long sequence of research on aerodynamic stability of suspension spans" that has resulted from the Tacoma Narrows Bridge collapse.

Data for Yearbook Sought

Early in June cards asking for information for the 1952 Yearbook will be mailed to all members, with the request that they be returned promptly if Yearbook changes in title or address are required. The cards should not be returned if changes are not needed. The Yearbook lists will close September 30, 1951.

UPADI Conference Called Example to World

Adoption of an ad interim constitution for UPADI, which was one of the major accomplishments of the recent Havana Conference (May issue, page 59), was hailed as "an act of paramount importance" and "an example to the world" in a stirring extemporaneous speech by Justiniano Posse, of the Argentinian delegation. Mr. Posse's brief talk so inspiringly emphasizes the aims of UPADI and the limitless frontiers of science and technology that it is repeated here. Speaking before the full plenary session at the Havana Conference with delegates from the engineering societies of twelve nations of the Western Hemisphere, he said:

"I beg to have the floor because I think that the importance of the act we have just accomplished should not be kept in silence. After many years of hard work facing innumerable difficulties we have found a formula—imperfect as all human things are, but still a final formula of understanding among all the countries of America.

"From now on we can proclaim for the future that, despite the unsettled condition of the world, despite the serious troubles the men on our planet experience in understanding each other, the Engineers of America do speak the same language although some of us pronounce it differently. We understand each other because we all agree in essentials based upon immutable formulas and principles under which we work together beyond limiting frontiers. Engineering problems transcend political limitations, they are debated on a wider field ruled only by nature itself.

"For us there are no national boundaries. At every moment the waters, winds, electrical waves and other forces trespass upon international frontiers and into the sovereignty of nations in open disregard of man-made laws and political inhibitions. Above and beyond political turmoil, the claims of sovereignty and the immutability of territories, we proclaim a fundamental principle: America is one; God made us one people in one continent and we must be united in the solution of our problems.

"I believe, Mr. President, that we have just accomplished an act of paramount importance, one of real substance which will stand as an example to the world, a lesson to our governments. I ask, Mr. President, that this act be consecrated by the unanimous approval of the assembly."

Committee on Student Chapter Meets in Cleveland

ADMINISTRATION OF STUDENT PROGRAM OF ASCE is planned by Society's Committee on Student Chapters meeting in Cleveland recently. Here group studies annual Chapter reports. Seated, left to right, are Finley B. Laverty, past-chairman; James M. Faircloth, chairman; and ASCE Director G. Brooks Earnest, Board Contact Member. Standing are Leo C. Novak, D. M. Griffith, Robert H. Dodds, and George W. Bradshaw.

Student Chapters Sponsor Large Regional Spring Conferences

PART OF GROUP attending third postwar conference of Upstate New York Chapters, held at Clarkson College of Technology on April 21, is pictured in top photo. Shown left to right, front row, are J. Baker, Clarkson, B. Campbell, Union, R. Duncan, Union, R. Gartner, Union, and E. Colligan, Clarkson; second row, D. Rosoff, Clarkson, G. Decker, R.P.I., E. Focth, Clarkson, J. Roy, Clarkson, and C. Malinka, Union; third row, A. Van Nostrand, Clarkson, M. Friend, Clarkson, T. Daly, Clarkson, R. Haight, Clarkson, and B. Frederick, Clarkson; fourth row, R. Andrews, Clarkson, P. Pappalardo, Clarkson, D. Kelly, Clarkson, J. Hawkins, Clarkson, G. Smith, Clarkson, and J. Albert, Clarkson. F. J. Doyle, of Syracuse Chapter, received first prize of $25 in student paper contest, and D. Rosoff, of Clarkson, second prize of $10.

ATTENDING ANNUAL CONFERENCE of Student Chapters in Rocky Mountain area at University of Wyoming are left to right, front row, Dean H. T. Person, Wyoming; Prof. W. A. Tingey, Utah State; Prof. T. O Reyhner, University of Denver Faculty Adviser; Prof. G. Koonsman, Faculty Adviser, Colorado State; ASCE Director George W. Lamb and Vice-President D. V. Terrell, guest speakers; and Prof. L. C. Novak, Faculty Adviser, Colorado University. In center row are D. Wright, treasurer, Wyoming; unidentified; J. Merrill, Utah State; unidentified; F. DeBello, president, Colorado University; R. H. Hahn, president, Colorado State; G. L. Jacobson, South Dakota Mines; and Prof. N. D. Morgan, Jr., Faculty Adviser, Wyoming. In last row are M. Harokopis, president, Wyoming; R. Greenwald, president, Denver; B. Wheeler, president, Utah State; J. Story, vice-president, Wyoming; B. Sikora, secretary, Wyoming; unidentified; unidentified; and Prof. E. Dake, Faculty Adviser, South Dakota Mines. Winners in prize paper contest were D. R. Lamb, of Wyoming, and G. Unguren, of Utah State.

TOTAL REGISTRATION of 378 sets new record for annual Student Chapter conference of schools in Philadelphia and Lehigh Valley Sections—held this year at Lehigh University, with ten schools participating. Program included talk by ASCE Director Francis S. Friel and inspection trip through Bethlehem plant of Bethlehem Steel Co. Winners in annual student paper contest were G. R. Koch, of Lafayette College, first prize; F. Masters, of Lehigh University, second prize; and R. V. Curry, of Villanova, third prize. R. N. Dippy, of Swarthmore, and L. A. Orlando, of University of Pennsylvania placed fourth and fifth.

NORTH CENTRAL CONFERENCE OFFICERS study calendar of events on the agenda of 1951 meeting at University of Dayton. These are, left to right, D. E. Grimme, treasurer; R. G. Shell, secretary; and G. T. Vance, president.

ASCE Local Sections Are Active in Defense Program

Civil defense activities of ASCE Local Sections—initiated last November at the suggestion of the Society—were reviewed at a recent Federal Civil Defense Conference held at the Statler Hotel in Washington. In response to the Civil Defense Administration's invitation to the Society to be represented at the conference, Frank L. Weaver, Director of the Society and ASCE delegate to the conference, summarized the defense activities of the Sections for the information and record of the conference.

He stated that, "To date about one-half the Local Sections have reported on their activities. All of those reporting state that their Sections are now working with the local civil defense authorities. The returns indicate a goodly percentage giving specific attention to shelter areas, the protection of utilities, including dams, and to plans for damage control."

Pointing out that the Local Sections "constitute reservoirs of men who are well organized and uniquely equipped by training and experience for assistance in civil defense, and especially in the vital fields of construction and utility services," Mr. Weaver noted that, "In addition to the activities of the Local Sections as organized groups, a large number of the members are employed individually, in all levels of rank, in vital defense services."

In conclusion, he suggested "that it would be a step in the more effective use of our Society and its members if the Federal Civil Defense Administration would particularly call to the attention of its local officials the ready availability of these local organizations and their desire to assist."

Engineering Foundation Reports on Its Research

Progress on fourteen research projects carried out under sponsorship of Engineering Foundation during the past fiscal year is reported. For the support of these projects, the Foundation made grants totaling $25,500 and industry and others contributed $967,045.

Three of the five current civil engineering projects are conducted by well-established councils, which support research at six universities. Work reported by the Council on Reinforced Concrete includes bending and axial-loading tests, shear and diagonal tests, and tests on large stepped columns. These and other tests under way are expected to aid the Council in attaining its major objective—the development of a workable theory and the formulation of a new code for the design of reinforced-concrete structures based on experimental data, to replace the empirical methods that have been used for many years.

Recent work by the Column Research Council has provided much new and valuable information on the buckling of columns, beams, and channels—information that is eventually expected to improve the design of compression members in buildings, bridges, and other structures.

Although the Research Council on Riveted and Bolted Structural Joints has been in existence only four years, the results of its work, particularly on the advantages of high-strength bolts instead of rivets in building construction, are said to be already evident. "In the usual construction of a large office or apartment building or a hotel," W. C. Stewart, chairman of the Council, points out, "the structural sections are bolted together temporarily, and as the riveting progresses the bolts are replaced by rivets. Thus there is the expense of putting the bolt in, taking it out, and replacing it with a rivet. Money can be saved if the original bolt can be left in place, and studies by the Council indicate that this is a safe procedure if high-tensile bolts are used and if the bolt is properly tightened."

Changes in Chicago Office of ESPS Are Announced

Leave of absence has been granted Joseph R. Decker from the managership of the Chicago regional office of the Engineering Societies Personnel Service, following his recall to active duty in the Civil Engineering Corps of the Navy with the rank of lieutenant commander. Appointment of Bonnell H. Allen as acting manager of the Chicago office is also announced by the ESPS.

EJC Issues First Report on Engineering Manpower

The Engineering Manpower Commission of Engineers Joint Council announces that its first report, entitled *Utilizing Engineering Manpower*, is available. Issued as E.M.C. Bulletin No. 1, the report presents procedures to be followed in requesting necessary occupational deferments and delays for both reservists and non-reservists (draftees). The bulletin also includes a brief statement on the problems of both government and industry in selecting and utilizing its technical personnel.

Copies may be obtained from the Engineering Manpower Commission, 29 West 39th Street, New York 18, N.Y., at a nominal charge of 25 cents each to cover the cost of handling and mailing.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Legislation

Only a few of the bills of interest in Congress have progressed beyond the stages reported in this column for April and May.

Assignment of Claims Act. The bill amending this act, H.R.3692–S.998, has become Public Law 30.

Defense Housing Bill, S.349, is still being considered by the House Banking Committee after having passed the Senate with radical changes.

War Damage Insurance. Hearings have been completed on this bill, S.1309, and a report is being prepared by the Bureau of the Budget.

Defense Production Act. Hearings are being held on S.1379, which would extend this act.

Air Force Organization Act of 1951. Engineers Joint Council has recommended certain changes in this act, H.R.1726. These recommendations, including specific reference to engineering in designing certain professions, have been presented both to the Air Force and to the Senate Armed Services Committee which is engaged in drafting changes in the proposed legislation.

Appropriations received by the Civil Defense Administration amount to about 10 percent of the $400 million requested for the current fiscal year. Other appropriation bills are taking heavy cuts. The House cut $62 million from the $559 million proposed for the Interior Department. For the Independent Offices, $693 million was cut from the $6,837 million requested. Hearings are now under way on a military budget calling for $40 billion for the 1952 fiscal year and $21 billion to be spent in subsequent years.

NPA Construction Controls

During May drastic changes have been made in NPA Order M-4 dealing with construction. This order which heretofore applied largely to commercial building construction was amended to cover almost the entire construction field, including single-family dwellings costing over $35,000. In general, a license is now required for any project using over 25 tons of steel. The construction of some types of structures is prohibited entirely. Certain exemptions remain in effect principally in connection with maintenance and repair, alterations not exceeding $5,000 in twelve months, reconstruction following fire or disaster where not over 25 tons of steel is required, construction for certain defense agencies, and facilities for which certificates of necessity have been issued.

The amended Order M-4 prohibits persons after October 26, 1950, from commencing "construction of any building, structure, or project to be used for, or in connection with, any of the purposes specified, as set forth in Section 15 of this order." Section 15 lists the prohibited construction as outdoor advertising signs, and "all buildings, structures, or projects to be used for, or in connection with any recreational, amusement, or entertainment purpose, whether public or private . . ." Sections 16 and 17 list those types of buildings, structures, and projects which require NPA authorization before construction can begin, as banks, community buildings, personal service buildings, hotels and motor courts, office and loft buildings, printing plants, structures for distribution or sale of wholesale and retail consumer goods, warehouses, residences costing over $35,000, apartments of more than three stories, radio and television broadcasting projects, and all public and private buildings requiring over 25 tons of steel.

Persons desiring to construct projects falling in the categories mentioned "may apply for a NPA authorization to commence such construction." The application must be made on NPA Form NPAF-24, copies of which are at all field offices of the Department of Commerce, and be filed at the field office "in the region of the site of the proposed construction."

Engineers' and architects' detailed plans and specifications, which are required to be submitted with the application, must be simple and give evidence that substitutes for critical materials have been incorporated to the maximum extent practicable. Applications, which must be filed at one of the 30 field offices, can be expected to be processed in from four to six weeks as in the past. Final decisions on applications are still being made in Washington, but this responsibility will probably be transferred to the field.

Exemptions from the provisions of the order are specified as maintenance, repair, alterations, and additions not exceeding a cost of 25 cents per sq ft per year, or a total cost of $5,000 per year, or a total use of steel not exceeding 25 tons.

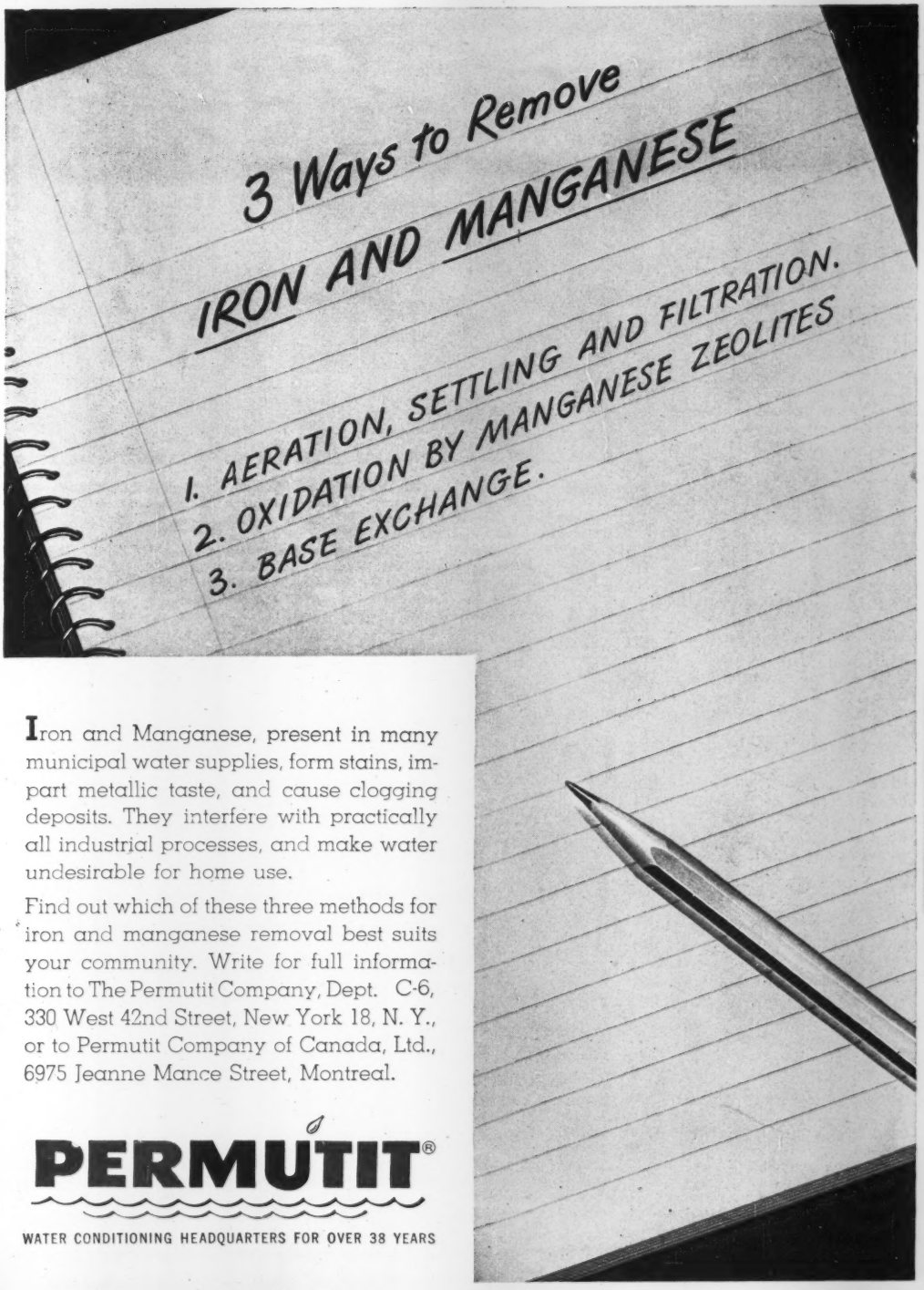
Although several of the basic regulations relating to the new Controlled Materials Plan have been issued, a proposed CMP regulation No. 6 dealing with construction is not yet ready. It will provide for CMP ratings (priority orders) for the steel, copper and aluminum needed for "programmed" projects. Such programs are prepared by the various claimant agencies designated by NPA from a survey of needs and within the amount of metals allowed by CMP authorities. For example, highway bridge needs will be programmed by the Bureau of Public Roads and submitted to the CMP Requirements Committee for approval of a certain total tonnage of steel, etc., for a given quarter. If demands are too great for the material available, the program will be adjusted downward to keep within the allowed tonnage. Orders for materials for such programmed projects (either public or private) will have an absolute priority. CMP Regulations 1 and 3 give the basic rules of the Controlled Materials Plan. Several booklets explaining the Plan are available from field offices of the Commerce Department.

While the licensing under Order M-4 is not integrated with the CMP system, a close relationship will have to be maintained between the two to avoid absurd duplication of work. A heavy construction job requiring special steel fabrication, even though licensed under Order M-4, would have hard sledding if it were not programmed for CMP help. Conversely, the CMP claimant agency should consider the M-4 criteria in programming projects to avoid a duplicate consideration for licensing. These complexities it is expected will be worked out in Regulation No. 6, to be available in June. Advice of the Advisory Committee named by NPA from among prominent engineers and others in the construction industry has not been sought in connection with these new developments.

Washington, D.C.
May 25, 1951

ASCE MEMBERSHIP AS OF MAY 9, 1951

Members	7,830
Associate Members	10,106
Junior Members	14,201
Affiliates	68
Honorary Members	36
Fellows	1
Total	32,242
(May 9, 1950	28,671)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District 10 Council Has Two-Day Conference

Delegates from the member sections of the District 10 Council attended the annual spring meeting of the District 10 Council in Charlotte on April 20 and 21. Also present to head discussion of various phases of Section operation and Society-Section relationships were William R. Glidden, Vice-President of the Society from Zone II, and Edmund Friedman, Director for District 10.

All arrangements for the meeting were made by Col. J. Norman Pease, vice-chairman, and Channing B. Brown, secretary-treasurer for the Council. Edward B. Rice of Raleigh, N.C., was conference chairman.

John F. Tribble, past-president of the Alabama Section, was elected chairman for the 1952 Council meeting. In taking over his duties as new chairman he extended the invitation of the Alabama Section as host for the Council meeting next year.

Papers in "Transactions" Obtainable as Reprints

In addition to selling bound volumes of TRANSACTIONS, of which over 14,000 copies are annually distributed on the basis of standing orders by members, the Society also sells individual reprints of TRANSACTIONS papers—a valuable method that is often overlooked. Though the cheapest purchase for a member is the bound volume ($2 in paper binding, $3 in cloth, and $4 in half leather) if a number of papers are desired, economy points to the method of purchase of individual papers when relatively few are needed.

All the papers from Volume 115 of TRANSACTIONS (1950) may now be bought separately, at prices varying from 20 cents to $1.40 each, non-member prices. A regular discount of 50 percent is granted to members.

Robert Ridgway Prize Recipients Announced

Award of prizes in the annual Robert Ridgway Prize contest, which honors the memory of ASCE Past-President Robert Ridgway, is announced by the Metropolitan Section. The prizes consisting of Junior membership in the Society go to outstanding Student Chapter members in the eight engineering colleges in the metropolitan area.

This year's recipients are: Joseph C. Bouchard, Rutgers University; Richard J. Schumm, Newark College of Engineering; Gustave J. Gustafson, Columbia University; Robert Dennee, Manhattan College; Stephen Ackerman, City College of New York; Jerome L. Sackman, Cooper Union; Alexander W. Mercil, New York University; and Louis J. Pignataro, Polytechnic Institute of Brooklyn.

CRAIG P. HAZELET, PRESIDENT OF KENTUCKY SECTION (right) presents first prize of $15 to W. R. Webster (next him) of University of Louisville, for paper on "Sales Engineering" at recent joint meeting of Section and Chapters of University of Louisville and University of Kentucky. Other winners in annual student competition are (left to right) J. A. Howard, of University of Kentucky, recipient of Kentucky Section ASCE Award; C. G. Mitchell, of University of Kentucky, second prize of $10 for paper entitled "Concrete Revetments Along Mississippi River"; Barbara Beam, of University of Kentucky, third prize of $5 for paper on "Women as Engineers"; R. S. Edwards, of University of Louisville, Kentucky Section ASCE Prize; Mr. Webster; and Mr. Hazelet. Kentucky Section ASCE Prizes, consisting of Junior initiation fee in Society and price of badge, are awarded to "outstanding graduating senior" at each school.

ATTENDING ALL-DAY SPRING MEETING OF TENNESSEE VALLEY SECTION, held at Kingsport, Tenn., on May 5, are (left to right) E. L. Chandler, Assistant Secretary of ASCE; Edmund Friedman, Director, District 10; William R. Glidden, Vice-President, Zone II; John C. Voorhees, secretary-treasurer of Tennessee Valley Section; and Armour T. Granger, Section president. Program included business and technical sessions, followed by inspection trip to Boone Dam project and picnic supper. Two University of Tennessee students—C. H. Montague and T. J. Isbelle—received Section's annual awards of Junior membership in Society for "achievement." S. N. Smith, of Elizabethton, Tenn., was chairman of spring meeting committee.

Remember the dates of the Louisville Convention—June 13–15. An account of the meeting and some of the papers will be published in the July issue.

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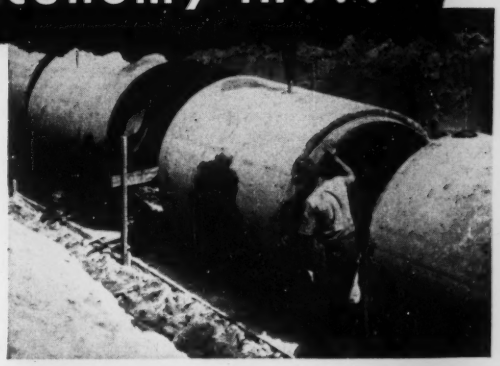
SANITARY SEWERS

For more than 100 years sanitary engineers have selected and specified concrete pipe for sanitary sewers because it meets all three essential requirements: (1) strength to resist severe impact and to sustain heavy overburdens, (2) durability to render many long years of heavy-duty service and (3) true *low-annual-cost* economy.



STORM SEWERS

Concrete pipe renders outstanding service in storm sewers because it carries off water efficiently. Its smooth, interior finish provides maximum hydraulic capacity and resists the wearing action of abrasive matter. Concrete storm sewer pipe is economical because it's moderate in first cost, has a long life and little or no maintenance cost. That's *low-annual-cost* service.

WATER LINES

Concrete pipe is ideal for water lines because (1) it can be designed to resist high internal pressures, (2) its joints can be made watertight, (3) there is no tuberculation and far less incrustation to impair hydraulic capacity and (4) it minimizes taste, odor and dirty water difficulties. Its reasonable first cost, combined with low upkeep and long life, give *low-annual-cost* service.

PORTLAND CEMENT ASSOCIATION

DEPT. A6-13 33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

Coming Local Section Events

Alabama—Summer meeting in Mobile on June 15 and 16.

Central Ohio—Meeting at the Chittenden Hotel, June 21, at 6:15 p.m.

Colorado—Dinner meeting at the Democratic Club, Denver, the first Monday of each month.

Columbia—Meeting in Walla Walla, Wash., on June 14.

Florida—Meeting at the Seminole Hotel, Jacksonville, June 12, at 7 p.m.

Georgia—Luncheon meeting at the Atlanta YMCA, the first Friday of each month, at 12:30 p.m.

Illinois—Weekly luncheons every Friday at the Chicago Engineers Club, at 12 noon.

Intermountain—Meeting in Salt Lake City on June 15.

Los Angeles—Field day at Oakmont Country Club, Glendale, June 25, at 4 p.m.

Miami—Dinner meeting at the Seven Seas Restaurant, Miami, the first Thursday of each month.

Oklahoma—Dinner meeting of the Oklahoma City Branch in the YWCA Building, Oklahoma City, June 15, at 6:30 p.m. Meeting of the Tulsa Branch in the Chamber of Commerce Building, Tulsa, the first Monday of each month.

Philadelphia—Meeting at the Engineers Club, Philadelphia, on June 12.

Pittsburgh—Picnic meeting for Junior Members at Rose Barn, North Park, June 15. Inspection trip to VA Hospital at Leech Farm, with luncheon following, on June 23.

Sacramento—Regular luncheon meetings at the Elks Club every Tuesday, at 12:30 p.m.

Tennessee Valley—Dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria, Knoxville, June 13, at 6:15 p.m.

Texas—Luncheon meeting of the Dallas Branch the first Monday of each month, at the Hotel Adolphus, at 12:15 p.m. Luncheon meeting of the Fort Worth Branch, the second Monday of each month, at the Blackstone Hotel, at 12:15 p.m.

Scheduled ASCE Conventions

SUMMER CONVENTION
Louisville, Ky., June 13–15
(Board of Direction meets June 11–12)

ANNUAL CONVENTION
New York, N.Y., October 22–25

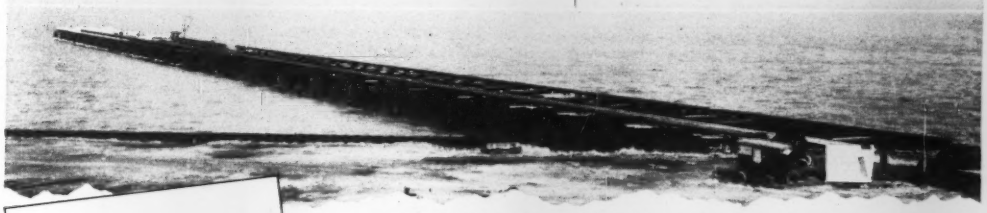
SPRING CONVENTION
New Orleans, La., March 5–7, 1952

SPEAKERS' TABLE AT SPRING MEETING OF WEST VIRGINIA SECTION, held recently in Morgantown, shows (left to right) Paul L. Holland, ASCE Director, District 6; Col. C. P. Hardy, district engineer, Pittsburgh District of the Corps of Engineers; W. R. Glidden, ASCE Vice-President from Zone II, who spoke on "Unity in the Engineering Profession"; Toastmaster R. P. Davis, dean of College of Engineering at West Virginia University; R. C. Quinn, vice-president of Section; and Wilfred Bauknight, president of Pittsburgh Section. Meeting was preceded by afternoon inspection trips to washing and screening plant of Weirton Mine Co. and new Morgantown Lock and Dam.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Akron	Apr. 24		Dinner meeting with Stanley Macomber, of Macomber Inc., Canton, Ohio, speaking on the young graduate engineer.
Arizona	Apr. 28		Spring meeting. Speakers included Fred H. Jobusch, architectural engineer, Tucson, Ariz., who talked on "A Complete Multiple-Story Rigid Frame"; Harry B. Rasch with Infilco, Inc., who discussed water treatment; Clyde E. Shields, field engineer, Lower Colorado River District of Bureau of Reclamation, at Yuma, who reported on "Construction of Irrigation System for the Welton-Mohawk Division of the Gila Project"; and Roy E. Goss, materials engineer, Lower Colorado River District, U.S.B.R., at Yuma, who outlined the laboratory design and control testing of construction materials. At luncheon featuring paper contest, Burt Struthers, of University of Arizona, received Section's Student Award, consisting of payment of fees for Junior Membership and badge. John A. Baumgartner was appointed editor of the *Arizona Section News Letter*.
Buffalo	Apr. 17	41	Luncheon meeting with John J. Hogan, regional structural engineer, Portland Cement Association, discussing the Walnut Lane Bridge in Philadelphia.
Central Illinois	Apr. 17	300	Joint dinner meeting with Illinois Structural Engineering Conference. "The History of Structural Engineering" was outlined by J. I. Parcel, partner in consulting firm of Sverdrup & Parcel, St. Louis, Mo.
Central Ohio	Apr. 19	27	A progress report of the Section's exploratory group on "The Increased Unity of Engineering Profession" was reviewed by Clarence Bowser. George Vaught, structural engineer with Portland Cement Association, gave an illustrated talk on prestressed concrete.
Cleveland	Apr. 20	...	A panel discussion on "The Relation Between the Engineer, Architect, and Contractor" was conducted by C. Merrill Barber, past-president of Section; Earl Pratt, president, Cleveland chapter, AGC; and Franklin Scott, member of AIA. Wendell R. Swatosh acted as moderator.
Colorado	Apr. 9	52	Dinner meeting featuring Carl N. Zangar, head of U.S.B.R. Photoelastic Laboratory, as principal speaker. Terry J. Owens, city engineer of City and County of Denver, reported on Denver's civil defense program. Orley Phillips with Phillips-

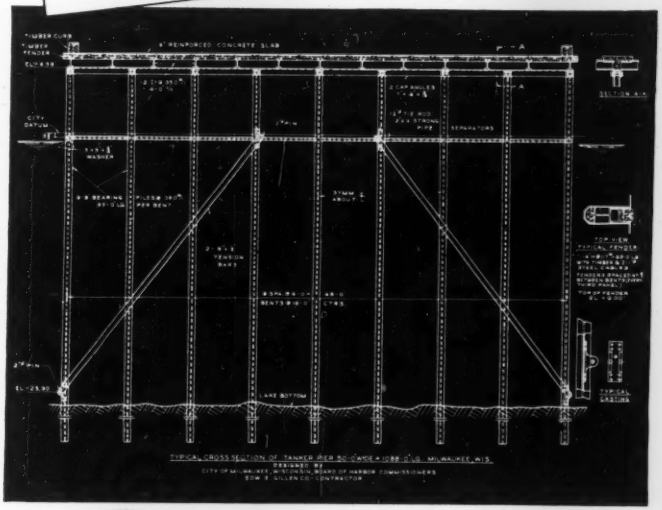
614 U·S·S Steel H-Beam Bearing Piles support this 1088-foot tanker pier



New all-steel tanker pier, designed by Board of Harbor Commissioners, City of Milwaukee, Wis. Edward E. Gillen Co., Milwaukee, steel structure contractor.

Milwaukee harbor structure eliminates storm flooding with open-type construction; makes use of tension members and unique fender system

● When Milwaukee's Board of Harbor Commissioners designed this new tanker pier, they were determined to eliminate the periodic flooding that northeast storms caused in the area surrounding an old closed-type pier. They accomplished this successfully with open-type construction utilizing U·S·S Steel H-Beam Bearing Piles. Under certain favorable conditions, this type of construction may prove economical.



The pier, 50 feet wide by 1088 feet long, consists of bents 16 feet on center. Each bent is constructed of nine 8-inch U·S·S Steel H-Beam Bearing Piles, capped by two 7 x 4 x 9/16-inch angles. On top of the angles are 13 rows of stringers—12-inch U·S·S Steel I-Beams spaced 4 feet on center. A 6-inch reinforced concrete slab rests on top of the stringers.

In place of batter piles, tension members were used, extending from the outside pile at lake bottom to the fourth column at water level. Careful alignment of bents was necessary and was accomplished by using pipe spacers and driving on outside columns until tension members were taut.

Each fender pile consists of two 14-inch U·S·S Steel H-Beam Bearing Piles 65 feet long, welded together and faced with wood. Two 1-inch wire cables, three feet apart, are wrapped around each fender pile and extend to and around each successive pile.

Safe, Permanent Foundations

Strong, permanent, easily-driven U·S·S Steel H-Beam Bearing Piles have proved their ability to provide a secure means of supporting foundations in unstable materials of great depth.

Their capacity for high unit loads, both vertical and horizontal, permits fewer piles and fewer driving operations for a given load. They are readily handled in the field with ordinary equipment . . . easy to splice . . . eliminate jetting . . . withstand rough handling.

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STEEL H-BEAM BEARING PILES

1-747A

UNITED STATES STEEL

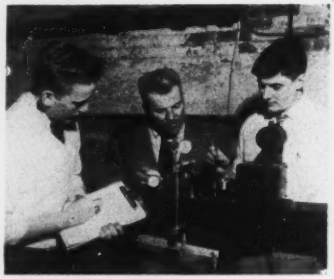
			Carter-Osborn, Inc., Denver, outlined activities resulting in passage of the Engineers' Registration Law.
Dayton	Mar. 19	47	Dinner meeting with ASCE Director G. Brooks Earnest discussing Society affairs.
District of Columbia	May 8	93	Archie N. Carter, manager, highway division, AGC; presented an illustrated talk entitled, "Transportation Developments from Maine to Alaska."
Florida	Mar. 20	...	H. C. Woods, retired engineer of Buffalo District, Corps of Engineers, presented an illustrated talk on the St. Lawrence Waterway.
Gainesville Sub-Section	Mar. 29	27	Prof. G. P. Boomsliter, of the engineering mechanics department, University of Florida, was principal speaker.
Georgia	Apr.	...	An illustrated address on the program of the U.S. Forest Service was presented by Mr. Hine, of U.S.F.S. staff.
Intermountain	Apr. 27	...	Joint dinner meeting with Utah State Agricultural College featuring a symposium on erosion problems on Bear River. The symposium was conducted by Melvin Greaves, senior design engineer, Robert A. Cummings, Jr. & Associates, with participation by Dr. J. Stuart Williams, head of geology department; Dr. O. W. Israelsen, professor of irrigation and drainage; James O. Henrie; Willis Barrett; and Jerald E. Christiansen, dean of school of engineering.
Kansas	Apr. 19	...	Joint dinner meeting with Kansas University and Kansas State College Student Chapters. Dr. F. D. Farrell, president emeritus, Kansas State College, was principal speaker.
Los Angeles	Apr. 11	158	Speakers included Lewis C. Coxe, commander, CEC, USN, who spoke on the Navy's construction program in Southern California; Henry L. Wright, architect, who discussed the planning problems of a major naval air base; and William T. Wright, structural engineer, who talked on the development of a prototype hangar for naval air stations. Meeting preceded by meeting of Junior Forum.
Metropolitan	May 16	...	Port Authority contributions to traffic relief in the midtown area were discussed by John M. Kyle, chief engineer for the New York Port Authority.
	May	...	Junior Branch meeting. Waldo Bowman, editor, *Engineering News-Record*, was principal speaker. Newly elected officers include Robert K. Lockwood, president; John Molloy, first vice-president; Paul W. Freitag, Jr., second vice-president; V. A. Smoots, secretary; and Joel E. Fischer, Jr., treasurer.
Miami	Apr. 5	...	August DeWinkler with Bushnell Steel Corp., explained the fabrication and handling of steel.
Mid-Missouri	Apr. 27	39	Dinner meeting. W. M. Spann, consulting engineer for Tuttle-Ayers-Woodward Co. of Kansas City, Mo., spoke on engineering registration and examination.
Northeastern	Apr. 25	105	Joint dinner meeting with Boston Society of Civil Engineers. The Boston Central Artery was discussed by Dr. John B. Wilbur, consultant for the firms of C. A. Maguire and Fay, Spofford & Thordike, and Edward C. Keane, assistant chief engineer.
Oklahoma Oklahoma City Branch	Apr. 4	...	Various research projects being conducted at the Oklahoma Institute of Technology were described by Professors Thompson and Boggs of the engineering research department there.
Providence	Apr. 24	35	Joint meeting with Rhode Island Society of Professional Engineers. G. A. Fasold, assistant director of research and R. F. Turner, sales manager for Phillip Carey Manufacturing Co., spoke on "Fire Underwriters' Class A Roofing."
Tri-City	Apr. 17	46	J. H. Corcoran, town grading engineer, Iowa Inspection Bureau, Des Moines, Iowa, stressed the engineering phases of the fire underwriters' boards and bureaus.

STUDENT CHAPTER NOTES

University of Hawaii

W. J. Holmes, head of the engineering department at the University of Hawaii and Prof. J. Gardner Bennett were principal speakers at the inaugural meeting of the university's Student Chapter of the Society. Goro Endo, president of the Chapter, received the charter and later the student members took the "engineer's oath." Formation of the Chapter, authorized by the ASCE Board of Direction at its Houston convention, was widely heralded in the local press.

ASCE DIRECTOR Sidney T. Harding (right), guest of honor at banquet meeting of University of California Student Chapter, receives plaque, depicting his recent appointment as emeritus professor of irrigation, from Bernard A. Etcheverry, professor of irrigation and drainage. Plaque was made and presented by Student Chapter members.



Worcester Telegram

EDMUND G. JOHNSON, Worcester Polytechnic Institute Student Chapter member, left, takes reading from machine that tests weight-supporting qualities of soil, while Paul F. Radasch, another Chapter member, explains operation of machine to John J. Reney, secretary of Worcester Society of Civil Engineers during joint meeting of two organizations.

Modern *Magic Carpet*

● This beautiful asphalt highway is truly the "modern magic carpet" for motorists and road-builders alike.

For pleasant travel there is nothing to equal the smooth, cushioned feel of an asphalt road. The unbroken, black surfaces are easy on the eyes; the absence of road glare makes driving easier and safer.

Asphalt helps highway departments and contractors reach new speeds in road-building. It is easy to lay; it sets rapidly. Aggregate already on the road or close at hand keeps material costs at rock-bottom low.

Care of an asphalt road takes a minimum of time, labor, and materials. Its beauty has a practical side—this road is long-wearing and water-proof.

Standard Oil helps road-builders even further through its five conveniently located refineries in the Midwest. Prompt and dependable deliveries are assured. A Standard Oil Asphalt Representative will be glad to suggest economical types of asphalt construction to meet your needs.

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NEWS BRIEFS . . .

Construction Activity for April Establishes Record for Month

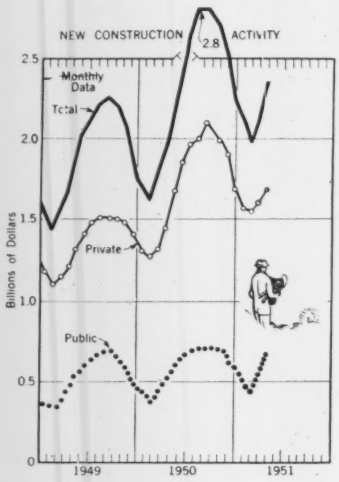
A seasonal rise in expenditures for new construction in April brought the total outlay for the month to $2,353 million, according to a joint report of the U. S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the Department of Commerce. Despite the fact that this total set a new record for the month, the joint agencies report indications that some types of construction activity have reached a turning point which will be reflected in future trends as the effects of materials shortages and various restrictions begin to appear.

The value of work on private residential buildings during the month came to $911 million—an increase of 7 percent over the value of residential building in March, but only 3 percent more than in April 1950. This small increase over April 1950 is attributed entirely to higher construction costs, since the physical volume of home-building activity was beginning to lag behind last year's record volume.

Construction of stores, restaurants, and similar commercial buildings was off slightly in April from the March level, with indications that the building peak in these fields had been passed. On the other hand, the volume of work on new private industrial plants continued to rise in April, with expenditures more than double the pre-emergency volume. Total private outlays for new construction during the month came to $1,688 million, an increase of 7 percent above the March total and of 14 percent over April 1950.

Increases in public expenditures for new construction during the month helped offset the declining rate of increase in private outlays. The rise in public industrial and military construction continued, and there were also seasonal increases in highway and reclamation projects. However, the volume of reclamation and flood control work was slightly under the April 1950 total, as a result of the deferment of projects not directly related to national defense.

During the first four months of 1951, new construction totaling almost $8.5 billion was put in place, in comparison with just over $7 billion in the corresponding period last year—an increase of 20 percent. Total private outlays of over $6.3 billion were 18 percent above those for the same period a year ago, and public expenditures of more than $2.1 billion were up to 25 percent.



SEASONAL RISE IN construction activity in April over total for March and for April last year is shown in Department of Commerce curves.

California Plans Huge Water Development Program

Preliminary plans for the solution of California's water-supply problem by the large-scale development and distribution of state waters are disclosed by A. D. Edmonston, M. ASCE, state engineer. Under authority granted by the state legislature in 1947, the California Division of Water Resources has been investigating the possibility of developing sources within the state instead of diverting surplus waters from other areas of the West. Preliminary findings of the Division indicate that two areas of the state—the Sacramento River basin and the north coastal area—have available supplies in excess of their ultimate needs.

In the north coastal area, according to Mr. Edmonston, there are more than 50 dam and reservoir sites "physically feasible of development to an aggregate reservoir capacity of 16,000,000 acre-ft and of production of more than 2,000,000 kw of electric power." This, he points out, is almost equivalent to the power output of all the present hydroelectric installations in the state.

In the Sacramento River basin, Mr. Edmonston states, there are more than 40 reservoir sites, with a potential storage capacity of 15,000,000 acre-ft that "are also feasible of development."

The plan for utilizing these sources would involve construction of a 675-mile canal, extending from the point of diversion in the San Joaquin delta in north-central California to its terminus as a tributary of the Tia Juana River in Southern California.

Development of the plan, according to Mr. Edmonston, is feasible of construction. In addition, "it is believed it would have a first cost less than any other plan and . . . could serve as a complete supplemental water supply for the full development of the south coast area and the desert areas in Los Angeles, San Bernardino, and Riverside counties."

The present Central Valley Project for irrigation, power and flood control will bring surplus waters from the Sacramento basin to the San Joaquin basin to the south by means of canals and a pumping plant. Started by the state, the project is being completed by the federal government.

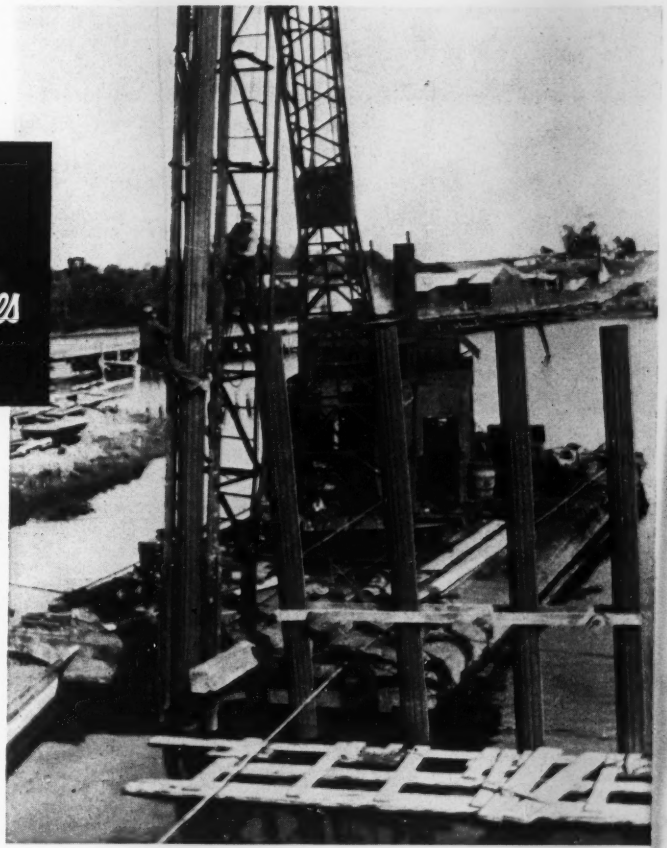
Professional Registration Laws in New York Amended

A bill sponsored by the New York State Education Department, amending professional registration laws, was passed by the 1951 legislature and signed by the governor on April 6. By this amendment, the fee for Professional Engineer licensure has been reduced from $25 to $20, and the fee for biennial registration has been increased from $2 to $5. In the other professions, the initial licensure fee was increased instead of reduced because the income from licensure and registration was not found sufficient to defray the cost of these operations, including enforcement. The new fees are designed to overcome deficits and to take care of the rising cost of operation.

By regulation of the Commissioner of Education, the fee for preliminary examinations remains at $15. The fee to be paid by Engineers-in-Training in order to take the final examination will be only $5. However, there has been a change in the law permitting candidates to retake examinations without additional fee. From now on, the cost of re-examination in one or more parts of the written examination will be a flat fee of $5.

Best Start for foundation cost savings!

Monotube taper-flute steel piles



USING every possible way to save construction materials, time and money is always important. Today it's doubly so. And one of your best ways is with Monotubes. Just see the advantages you gain with these cast-in-place steel piles!

MATERIALS CONSERVED

Monotubes' tapered design and cold-rolled properties not only *save steel,* but also provide unusually high bearing values and exceptional lateral stability. So it's not uncommon to meet load-bearing requirements with less driving . . . or even *fewer* piles. And, because Monotubes are readily extendible on the job, with easy cut-off and simplified weld-splicing, further materials conservation is afforded.

TIME AND MONEY SAVED

You can see how materials are saved —*plus* time and money. And there are *more* economies! Monotubes' taper-flute design results in faster driving. Lighter, standard driving equipment can be used on most jobs. And, Monotubes' light weight makes handling and locating faster and easier.

GET COMPLETE INFORMATION

Send for all the interesting facts about Monotubes. Find out how their many advantages can help you save right at the start of your construction projects. For complete data, write The Union Metal Manufacturing Company, Canton 5, O.

UNION METAL

Monotube Foundation Piles

New York Central to Build New Harlem River Span

NEW FOUR-TRACK, VERTICAL LIFT BRIDGE, to be built by New York Central over Harlem River, is shown in architect's drawing. Replacing present 54-year-old bridge between Manhattan and the Bronx at East 133rd Street, new steel span will carry all New York Central and New Haven and Hartford trains using Grand Central Terminal. Totaling 2,227 ft in length, new structure will provide above-water clearance of 135 ft and single, 225-ft channel for vessels instead of present two 100-ft channels. It will open and close in less than half the 9-minute period required by present swing span. Starting now and scheduled for completion in 1954, construction will permit coordination of bridge and its approaches with projected city and state highway improvements. Costs will be in excess of $10,000,000. Design of project is in charge of New York Central Engineering Department, with New York firm of Hardesty & Hanover consultants for towers and machinery of lift span.

Canadian Technical Projects Are Reviewed at EIC Annual Meeting

Construction of an all-Canadian, year-round, deep-water channel from Lake Ontario to the sea was advocated as technically and economically feasible by J. G. Kerry, M. ASCE, of Port Hope, Ontario, in a paper on the St. Lawrence Waterway presented at the 65th annual meeting of the Engineering Institute of Canada, held in Montreal, May 9–11. Mr. Kerry, who has devoted years of study to ice conditions of the St. Lawrence River, stated that such a seaway can be kept free of ice by utilizing the latent heat in the deep waters of Lake Ontario.

He also advanced a proposal for construction of a deep water canal from Galops Island near Iroquois, across the St. Lawrence lowland to empty into the Ottawa River near Point Fortune. Here power could be developed along lines generally similar to Beauharnois, he pointed out. As a preliminary step to working out the projects, Mr. Kerry suggested that the government be urged to study and record annual temperature cycles of Lake Ontario and to explore by accurate surveys the possibility of a cut-off canal connecting the two main rivers—the St. Lawrence and the Ottawa.

Other speakers on the comprehensive technical program included Richard L. Hearn, M. ASCE, general manager and chief engineer of the Hydroelectric Power Commission of Ontario. Stating that Ontario, Quebec and New York State are already interconnected, Mr. Hearn forecast "a vast network of power lines stretching from Manitoba on the west to Quebec on the east and from James Bay in the north to New York State and Michigan in the south." Mr. Hearn stated that studies are being made in several provinces of the possibility of further interconnections with the United States that would be beneficial in time of emergency.

He described steam generating stations currently under construction by the Commission in Toronto and Windsor and the proposed redevelopment of Niagara Falls. To be known as the Sir Adam Beck-Niagara generating station No. 2, the proposed unit will operate under a 300-ft head instead of the present heads of 135 to 180 ft at the Toronto and Ontario power plants at Niagara Falls. Scheduled to be in operation in 1954, the proposed station will have a capacity of 450,000 kw.

At the annual banquet, culminating feature of the three-day program, award of Institute medals and prizes was made by James A. Vance, M. ASCE, of Woodstock, Ontario, retiring EIC president. Recipients included C. R. Young, M. ASCE, dean emeritus of the faculty of applied science in engineering, University of Toronto, who was awarded the Sir John Kennedy Medal for a technical paper on "The Legal Position of the Engineer."

The new president of the Institute is Ira P. Macnab, general manager of the Halifax Public Service Commission. New vice-presidents, also installed during the meeting, are J. W. Sanger, representing the Western Provinces; C. G. R. Armstrong, representing Ontario; and J. B. Stirling, representing the Province of Quebec.

Increased Water Supply Planned for San Diego

An interest-free loan of $105,000 recently approved by the Housing and Home Finance Agency will advance engineering studies and the preparation of design drawings for the completion of an impounding dam on Santa Ysabel Creek in the San Dieguito watershed. The project includes completion of Sutherland Dam, which was undertaken in 1927 and stopped the following year, and construction of a pipeline to the San Vicente Reservoir Drainage Basin. Located about 35 miles northeast of San Diego, the dam will be 1,025 ft long and 158 ft high, and will provide a storage capacity of 36,724 acre-ft.

The population of San Diego has doubled since 1940, and the location of many defense activities during the war necessitated bringing Colorado River water to the area years ahead of its anticipated schedule. The Santa Ysabel Creek is the last stream in the area to be developed as a source.

Contract Given for Large VA Hospital in Massachusetts

Award of an $17,737,000 contract to the Gust K. Newberg Construction Co., of Chicago, Ill., to build a 1,000-bed hospital at Brockton, Mass., is announced by the Veterans' Administration. Located on a 217-acre site, the 11,500,000-cu ft VA hospital will include eight medical, surgical, treatment, and rehabilitation buildings as well as staff quarters and facilities.

High Costs, Heavy Traffic Force Toll Road Return

Tremendous increases in highway construction costs and in traffic volume are largely responsible for the return of toll roads throughout the country, according to the Brookings Institute. The fact that more than half the states have adopted toll roads is attributed principally to inflation, restrictions on state bond issues, and opposition to tax increases. In addition, the Institute finds that the present policy of distributing highway funds makes it almost impossible to obtain larger allotments for improving roads where traffic is heaviest.

Findings of the Institute are reported in a 200-page volume, *Toll Roads and the Problem of Highway Modernization*, prepared by Wilfred Owen and Charles L. Dearing. Published by the Institute, 722 Jackson Place, N.W., Washington, D.C., the report sells for $2.50.

New York is cited as one of the states making successful use of toll roads for important intercity routes. Similar roads are also being built in New Jersey, Pennsylvania, Maine, Ohio, and other Eastern states.

Analyzing the Westchester County (New York) parkways, the Merritt Parkway in Connecticut, and the Pennsylvania Turnpike, the report points out that returns from these projects vastly exceed operating costs even after deductions for payments on state loans. Trips over the Merritt Parkway involve two stops instead of the average of 39 stops required on parallel route U.S. Route 1, the survey shows. Most important of all, the fatality rate on the free lane is four and a half times greater than on the parkway.

Despite the advantages of toll roads, the report warns that they cannot be a cure-all in view of the vast postwar increase in motor vehicles. Another disadvantage is that they cannot be used in congested metropolitan centers. None the less, the report concludes that "where federal-state cooperation on the free-road system has failed to achieve prompt modernization, it might be possible for a selective development of toll highways to succeed."

AEC to Build Uranium Ore Refinery in Ohio

Early construction of a uranium ore refinery and other facilities for the production of uranium feed materials, near Cincinnati, is announced by the Atomic Energy Commission. To be located on a 1,200-acre site near the Miami River, 19 miles northwest of downtown Cincinnati, the Feed Materials Production Center will produce uranium in forms suitable for use at the Commission's fissionable materials production plants. Costs will be around $30,000,000.

The new facilities are being designed by the Catalytic Construction Co., of Philadelphia, and the George A. Fuller Co. will be the construction contractor. The National Lead Co., of New York, has been selected as operating contractor for the center.

Approximately 3,000 persons will be employed during the peak construction period, and the Center will require a permanent operating force of about 1,200. Construction and operation of the Center will be under the supervision of the newly established Fernald Area of the New York Operations Office of the AEC. James F. Chandler, a civil engineer, has been named area manager, with temporary headquarters in Cincinnati.

Aluminum Production Rises 5 Percent in First Quarter

Production of primary aluminum in the United States during the first quarter of 1951 advanced 5 percent over the total for the last quarter of 1950, according to Donald M. White, secretary of the Aluminum Association. The industry turned out 140,044,429 lb of primary metal in March, to bring the quarterly total to 401,431,462 lb, compared with 382,176,940 lb for the previous quarter.

"This is about 25 percent more than was produced during the first quarter of 1950," Mr. White reports, "reflecting the industry's continuous efforts during the year to increase its production. Nevertheless, the combined military and civilian demand is still much greater than the available supply."

Dealer Service Aids Equipment Conservation

TO MEET DEFENSE NEEDS for conservation of serviceable parts in heavy equipment industry, many dealers are installing facilities for lowering reconditioning costs and reducing shortages of parts. Problems involved in conservation of track rollers and idlers are solved by such equipment as this automatic welding machine which is being used by Peoria Tractor & Equipment Co., "Caterpillar" dealer in Peoria, Ill. With use of this unit, which is made by Leader Welding & Manufacturing Co., Berkeley, Calif., complete set of worn Caterpillar D8 Tractor Rollers can be built up and put back on machine in 24 hours.

First Aluminum Traffic Control Arches

FLOW OF TRAFFIC OVER HEAVILY TRAVELED Delaware River Bridge between Philadelphia and Camden, N. J., is regulated by eight traffic control arches, said to be the first such structures to be made of aluminum. Each arch holds 16 red and green signal lights to indicate which lanes are closed and which are open to traffic. Spaced at intervals of 750 ft along the 1.8-mile span, the arches make it possible to control traffic for entire length of bridge. Formerly there had been only two control arches, located at the bridge towers. Each arch is 84 ft long, 4 ft wide and 5 ft deep, and weighs 8,700 lb. They are manufactured of Alcoa aluminum by Pittsburgh-Des Moines Steel Co.

JOHNS-MANVILLE PRODUCTS

Johns-Manville

tax savings for the future

Three billion, two hundred and fifty million dollars*—that's what it will take to foot the bill for new water system construction so urgently needed by the American people during the next ten years!

For the thousands of communities that must carry a share of this additional investment, the vital need for water system expansion is most unwelcome at this time in the face of constantly rising costs.

This means that, wherever possible, water works officials will be called upon to keep an exceptionally close watch on expenditures . . . to see that the money laid out for new systems brings the greatest possible return to the taxpayer.

Since a sizable part of the cost of any water system involves the supply and distribution lines, an important question to be answered by these officials will be: "Which pipe will give the greatest return from this portion of our investment?"

Thousands of communities have already found the answer to this question in Transite Pressure Pipe.

A threefold warranty of economy is built into every length of Transite Pressure Pipe . . . the modern pipe developed by Johns-Manville through research and engineering to carry water more efficiently:

1. ***Long service life*** . . . because Transite Pipe is made of three inherently corrosion-resistant materials—asbestos, cement and silica—and is steam cured under pressure by a special Johns-Manville process which assures *maintained strength in service.* Carefully kept records of performance in highly corrosive soils prove that conditions which seriously weaken other pipe materials have little effect on Transite.

2. ***Low operating costs*** . . . because Transite Pipe has a smooth interior surface which provides a high water-carrying capacity (C=140). Moreover, because Transite cannot tuberculate, this high carrying capacity *remains* high through the years. Pumping costs, as a result, stay low. Delivery of a full volume of water at lowest operating cost is assured.

3. ***Maximum water economies*** . . . because Transite Pipe has tight, yet flexible joints that *stay* tight in service. These joints absorb vibration and soil stresses, cut down on costly underground water leakage. This is especially important today when water supplies in many localities must be conserved to the limit to meet constantly increasing water consumption.

In addition to these assurances of tax savings for the future, Transite Pressure Pipe offers many *immediate* economies, such as important savings in time and money during installation . . . further sound reasons why it will pay you and your community to specify Transite for the greatest return from your pipe investment.

*From THE WALL STREET JOURNAL, May 26, 1950

For complete information write Johns-Manville, Box 290, New York 16, N. Y.

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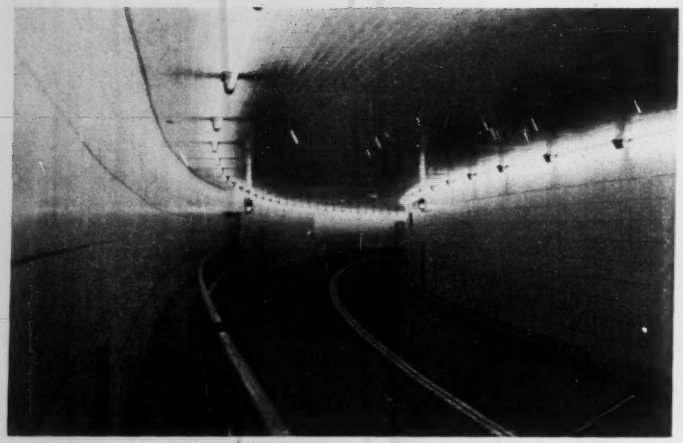
Transite is a registered Johns-Manville trade mark



INNOVATION IN DESIGN OF PATROL WALK for recently completed Battery Park Underpass permits saving of 2 ft 8 in. in net width of Underpass for its entire length. Wall (shown at left) separating the two roadways alternates on one edge of walk, then on the other, so that one patrolman can police both roadways.

Unique Patrol Walk Reduces Cost of Battery Park Underpass

WALTER D. BINGER, M. ASCE

Consulting Engineer, New York, N.Y.

During the progress of the design of the Battery Park Underpass it was the writer's good fortune, while Manhattan Commissioner of Borough Works, to hit upon an idea which, though original and untried, proved to be suited to use without experiment. It resulted in a novel form of patrol walk in that structure.

The common way of patrolling a vehicular tunnel, as everyone knows, is from two elevated walks, one in each traffic lane. These may be on either side of the separation wall, or partition, which must be continuous to insure air flow in the direction of the traffic. Or the patrol walks may be on the opposing outer walls. In the Battery Underpass it was first proposed to build them adjacent to the partition.

As built, there is only a single walk. The partition is placed on one edge for a certain distance and then on the other edge and so on. The distances vary because the drive consists of a long curve of differing radii, between tangents. The average length of walk on a given side of the partition is 120 ft. The shortest stretch is 98 ft; the longest 164 ft.

At the point of change there is a cross wall consisting mostly of a glazed counterbalanced door. The engineers who were charged with the development of the design cleverly placed these cross-over doors at a 60 deg angle so that by opening them only 30 deg the patrolman can continue to walk in a straight line.

A patrolman thus inspects alternate traffic lanes about every 120 ft. Even at the snail's pace of one mile per hour he is generally back in a given lane within a minute and a half after he leaves it. Also, for the greater part of the 2,700 ft of the tunnel's length, he can see far enough so that the entire section next but one ahead is visible. Only on the outer edge of a curve is his vision somewhat restricted.

The result of this design innovation is twofold. First, there is a saving of 2 ft 8 in. of net width of the Underpass along its entire length. Second, there is an obvious, though perhaps indeterminate, reduction in the number of patrolmen required for policing. It may cut the number in half.

The question naturally arises as to what limitations the system may have which would render it useful only in special cases. The writer sees none but perhaps some will develop.

Opened in April 1951 (May issue, page 68), the Underpass was designed and supervised by engineers in the office of Robert F. Wagner, Jr., president of the Borough of Manhattan.

Philadelphia Plans New Industrial Land Use

As the culmination of a five-year study of industrial land use possibilities in metropolitan Philadelphia, the City Planning Commission reports a plan that will provide 50 percent more space within the city limits for expanding manufacturing needs. According to the report, made public by Edward Hopkinson, Jr., commission chairman, rearrangement and more efficient use of the land already available in the city will increase the area available for general manufacturing from 6,400 to 12,800 acres, sufficient to meet needs for the next 30 years.

The proposal calls for replacing scattered factories with concentrated plant locations in reserved industrial districts to be created in several areas—principally sections of Northeast Philadelphia, the Aramingo section of North Philadelphia, and the reclaimed Eastwick section in the southwestern part of the city. Placing various types of industry in districts best suited to the particular needs of the industry, according to the report, will provide opportunities for industrial employment in every section of the metropolitan area.

The large increase in industrial land requirements as compared to industrial employment is attributed to "increased mechanization, greater use of one-story buildings by mass production industries, and greater need for parking and recreation areas, and landscaping."

Large Aluminum Plant to Be Built in Washington

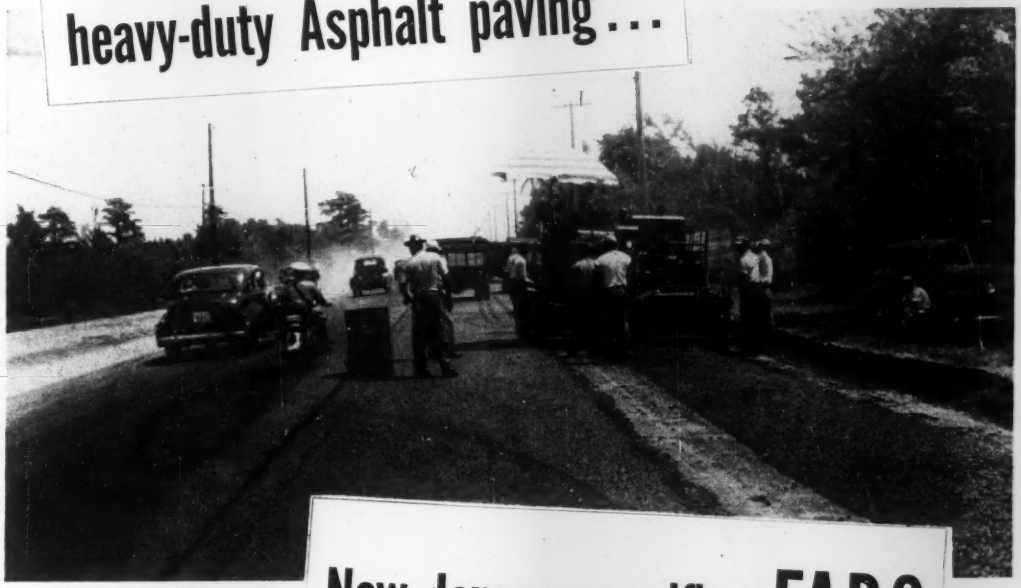
To meet the need for increased aluminum production for defense requirements, the Aluminum Company of America will build a new aluminum smelting plant with an annual capacity of 170,000,000 lb, at Wenatchee, Wash. Construction of the new works will start immediately, with production of aluminum scheduled to begin within 15 months.

Recent negotiations between the company, the Bonneville Power Administration, and the Public Utility District of Chelan County assure provision of the necessary electric power for operation of the plant.

Geological Survey Sets Up District Office at Topeka

Establishment of a new district office of the Surface Water Branch of the U. S. Geological Survey at Topeka, Kans., to direct cooperative federal-state surface-water investigations in the state is announced by the Department of the Interior. District engineer of the new office will be Jacob B. Spiegel, M. ASCE, who has served in Survey offices in Arizona, Colorado, Iowa, and Kansas since 1914.

When a highway needs heavy-duty Asphalt paving...



This section of White Horse Pike in New Jersey was widened and resurfaced with a two-course Fine-Aggregate Bituminous Concrete pavement by Eastern Engineering Company of Atlantic City.

New Jersey specifies FABC

White Horse Pike is one of New Jersey's busiest east-west highways, linking Camden with Atlantic City, world-famous ocean resort. When a large mileage of the Pike called for resurfacing, the State specified Fine-Aggregate Bituminous Concrete paving, commonly known as FABC. Year after year, this dense, rugged, joint-free type of hot-mix paving has been constructed on important streets and highways throughout the State. Its ability to absorb punishing impact with a minimum of maintenance has become well-established.

A factor which many of New Jersey's FABC projects have had in common through the years has been the use of Texaco Asphalt as binder in the mix. Produced from selected crudes under skilled supervision by the most modern refining methods, this asphalt has served road builders of New Jersey for more than 40 years. A Texaco-paved street in Newark continues to give satisfactory service after 43 years.

Helpful information on Asphaltic Concrete, as well as the various other types of asphalt construction for roads, streets and airports, is presented in two booklets, which may be obtained free by writing our nearest office.

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Building Research Congress to Be Held in London in Fall

Invitations to attend the Building Research Congress, to be held in London from September 11 to 20, have been accepted by more than a thousand civil engineers, builders and others concerned with problems of building materials and structures. Arranged by the United Kingdom Scientific Mission in response to widespread post war interest in research in building materials, the congress will be the first of its kind ever held in Great Britain.

Details may be obtained from the Organizing Secretary, Building Research Congress 1951, Building Research Station, Watford, Herts, England.

Record Iron Ore Imports in 1950 Bolster U.S. Supply

The largest amount of iron ore ever imported—nearly 9,200,000 net tons—came into the United States last year from 15 foreign countries, according to the American Iron and Steel Institute. This amount, which exceeded the 1949 total by about 1,000,000 tons, constitutes approximately 8 percent of the domestic production of iron ore, or double the proportion to domestic ore in 1946.

With numerous foreign mines being developed, continued expansion of imports is promised. In addition to Venezuela, which recently sent its first cargo of iron ore to the United States, work is being done on newly prospected deposits in Africa, Chile, Canada, and Labrador. The largest foreign sources of iron ore last year were Chile, Sweden, and Canada-Newfoundland in the order named.

Advance Planning Funds Go for Raritan River Clean-up

Preliminary plans and engineering studies for a $29,700,000 project to clear pollution from the Raritan River in New Jersey will be made by the Middlesex County Sewerage Authority with an interest-free advance of $100,000 authorized by the Housing and Home Finance Agency. Pollution surveys of the Raritan Valley have been under way since 1926, and it is estimated that the river now carries a pollution load equivalent to a population of more than 1,000,000 persons. Water from the river and its tributaries is used for domestic and industrial purposes, despite the imminent danger to public health and the unsuitability of the water for some industrial uses.

The present project calls for sewer and sewage installations, including a 22½-mile trunk-line sewer to follow generally the course of the river from the Borough of Raritan to a pumping station, to be built at the junction of the river and the Washington Canal. The pumping station, which will have a capacity of 170 mgd, will also receive sewage flow from a 4½-mile trunk sewer to be built along the course of the South River.

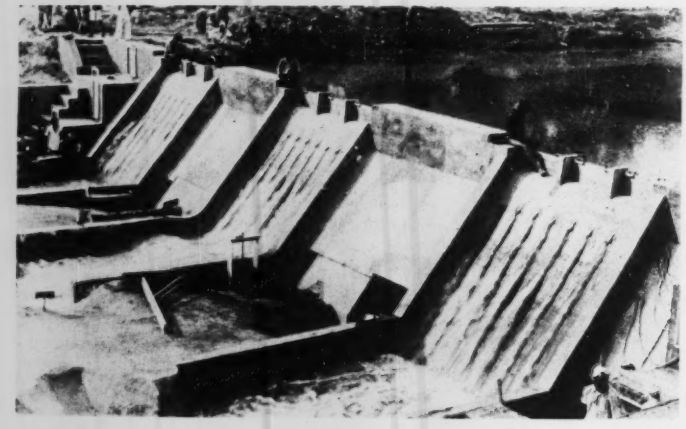
From the pumping station the sewage will be carried through a large force main to a treatment plant with a capacity of 95 mgd to be built near Raritan Bay. After primary treatment and chlorination the effluent will be discharged through a submarine outfall sewer with multiple outlets extending about two miles into the bay.

President's Safety Conference Scheduled for June 13–15

This year the President's Highway Safety Conference, to be held in the Interior Auditorium, Washington, D. C., June 13 through 15, will be built on the original 1946 pattern of developing committee reports during the actual meeting. Though the general theme of the conference will be the relationship between highway safety and the national emergency, the agenda will consider ways of carrying the Action Program into the states and communities, obstacles that have been encountered in the past five years, and items most in need of emergency attention.

Though not a full-scale affair, the conference will be larger than the progress report meetings of 1948 and 1950. The Committee on Organized Public Support will again be headed by Harold P. Jackson, with Dr. John W. Studebaker as vice-chairman and Paul H. Blaisdell as secretary.

Large Models Advance Design of Bhakra Dam Spillway



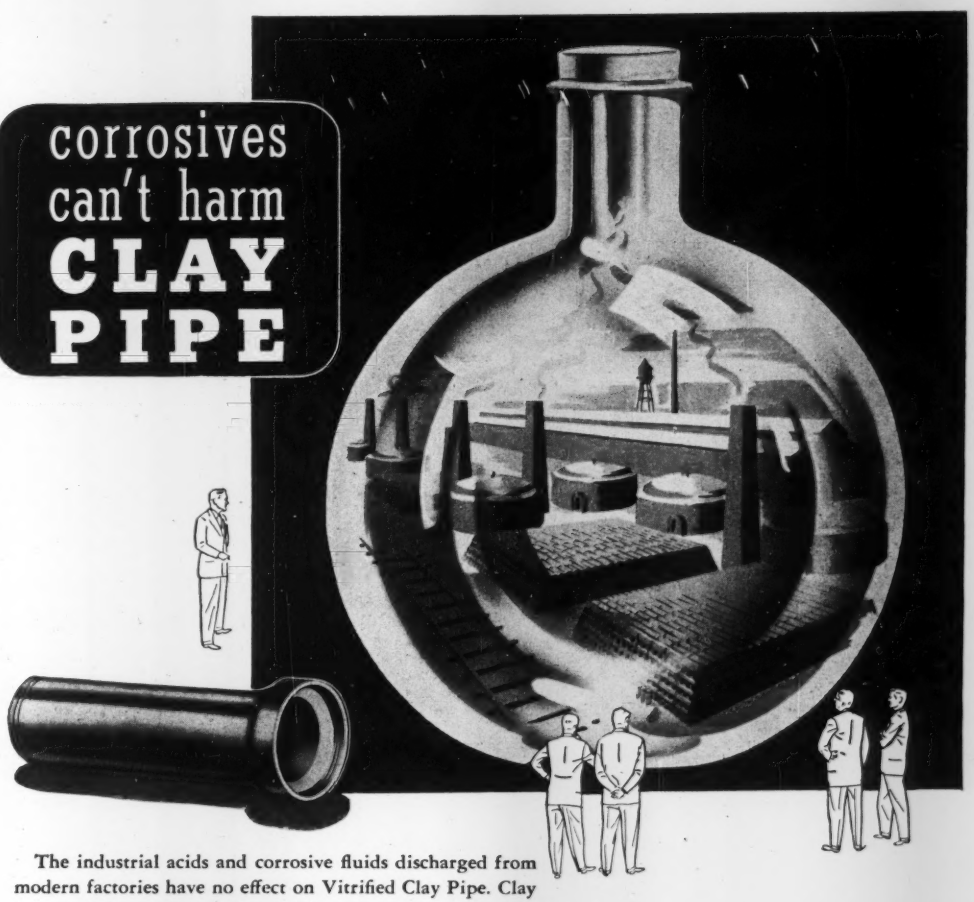
THREE ALTERNATIVE DESIGNS for proposed spillway of Bhakra Dam in India are under study at Hydraulic Research Station of East Punjab Government, Malakpur, India. Constructed side by side, three models are built to scale of 1:44 and have total discharge of 100 cfs. ASCE Honorary Member John L. Savage, retired chief designing engineer for Bureau of Reclamation on construction of some of world's largest dams, recently visited the station in connection with the spillway experiments. Original model studies for Bhakra Dam, made at Colorado A. & M. College, were described in "Civil Engineering" for August 1950, page 70.

Inventory of Construction Equipment Proposed by AED

A nation-wide survey of construction machinery and trained personnel to determine "the nature and ownership" of available construction equipment, and location of trained operators, was urged in a recent resolution passed by the National Affairs Committee of the Associated Equipment Distributors. Information collected in such a survey would be indexed and made available to authorized civil defense authorities on national, state, and municipal levels, the resolution states.

Contemplated wide-scale purchases of construction machinery by all levels of government is deemed dangerous to the economy of the country. "In the event of catastrophe," the AED states, "the necessary personnel and construction equipment could be mobilized immediately, after the proposed survey results are indexed, thus obviating the need for excessive stockpiling of construction equipment."

corrosives can't harm CLAY PIPE



The industrial acids and corrosive fluids discharged from modern factories have no effect on Vitrified Clay Pipe. Clay is completely immune to any form of corrosive chemical activity, whether it's sewer gas, industrial waste, or the destructive acids found in sewage. Today, with chemistry involved in nearly half the nation's total production, it's more important than ever to install sewerage and drainage lines that are chemically inert — proof against the acids and soil conditions of today . . . and of tomorrow. *Every* city of *every* size needs Vitrified Clay Pipe — the *only* pipe that never wears out.

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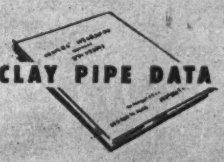
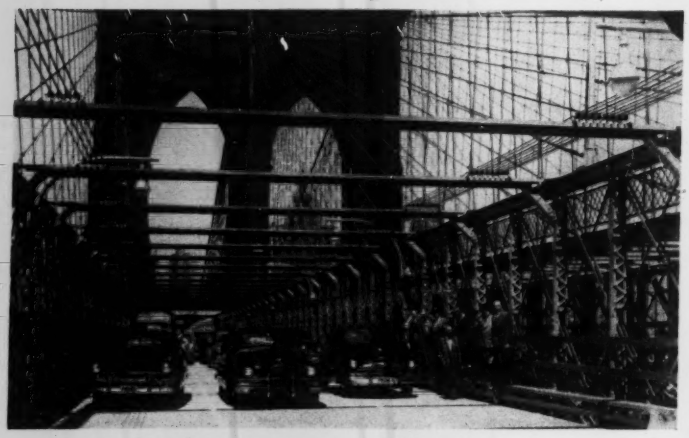
SPECIFY *Vitrified* **CLAY PIPE**



WRITE FOR DETAILED INFORMATION
Additional information and data on Vitrified Clay Pipe, Wall Coping and Clay Flue Lining sent FREE on request. State your specific questions. Simply contact the regional office nearest you.

C-151-10

Three-Lane Roadway Is Opened on Brooklyn Bridge



RENOVATION OF BROOKLYN BRIDGE, begun early in 1950, is partly completed with opening to traffic of south roadway on May 2. Part of $3,317,536 reconstruction project, rebuilding of south roadway included addition of third lane. North roadway, which has been carrying all bridge traffic since start of reconstruction, has now been closed to permit a similar improvement, scheduled for completion by end of this year. Accelerated construction schedule for north roadway work is made possible by experience gained in solving special engineering problems on first half of job. Renovation project includes removal of trolley tracks in center of bridge to make room for the two additional vehicular traffic lanes and replacing old pavement of wood blocks with steel and concrete surfacing. When reconstruction is completed, bridge will accommodate 6,000 vehicles an hour, double its former capacity. D. B. Steinman, M. ASCE, of New York is consulting engineer on project, and J. A. Klevens Corp., of Brooklyn, contractor.

Role of Water in Defense Production Studied by Pollution Control Body

The need of industry for greater supplies of usable water to meet defense production schedules was emphasized in discussions before the Water Pollution Control Advisory Board of the Public Health Service at a recent two-day conference in Washington. The Board, consisting of six members appointed by the President and representatives of four federal agencies, was established by the Water Pollution Control Act of 1948 to review policies and programs of the Public Health Service.

Carl E. Schwob, chief of the Division of Water Pollution Control of the Public Health Service, told the Board that, while the pollution control program has not been changed in substance by defense activities, "the emphasis will of course be changed so that critical defense areas will be given priority over other areas in control of pollution problems." A member of the Board, L. A. Danse, supervisor of materials and processes, Production Engineering Section, General Motors Corp., declared that industry must have greater supplies of good water immediately to fill its defense orders. It would be fatal to the defense effort, he said, to overlook the fact that "we can't make steel or anything else without water."

Prospects for sewage and industrial waste treatment plant construction were discussed with Jack Bilby, director of the Civil Requirements Division, Defense Production Administration. Asked whether materials would be allocated for this type of construction, Mr. Bilby said that arrangements are being made to take care of water supply and sewage disposal needs pending the designation of a claimant agency of the government for these functions. He said it is expected the designation will be made soon and that, in the meantime, the DPA staff is compiling necessary information on which to base allocations of materials for water resources projects.

The efforts being made by industry to increase its supplies of usable water were described by Louis Warrick, chief of the Technical Service Branch of the Division of Water Pollution Control. He mentioned the $25,000,000 program to fight pollution currently under way in Philadelphia and cited "waste guides" which are being set up at the Public Health Service's Environmental Health Center at Cincinnati, Ohio, as potentially "of much help in promoting waste utilization or treatment and stream improvement."

Mark D. Hollis, M. ASCE, Assistant Surgeon General and chief sanitary engineering officer of the Public Health Service, presided as chairman of the Board. Other ASCE members present were T. A. Berrigan, chairman of the Merrimack River Valley Sewage Board, Boston; Harold A. Kemp, chairman of the Interstate Commission on the Potomac River Basin; A M Rawn, chief engineer and general manager of the Los Angeles County Sanitation Districts, Los Angeles; Melvin Scheidt, of the Bureau of the Budget; and N. T. Veatch, consulting engineer of Kansas City, Mo.

Navy Reviews Major Construction Program

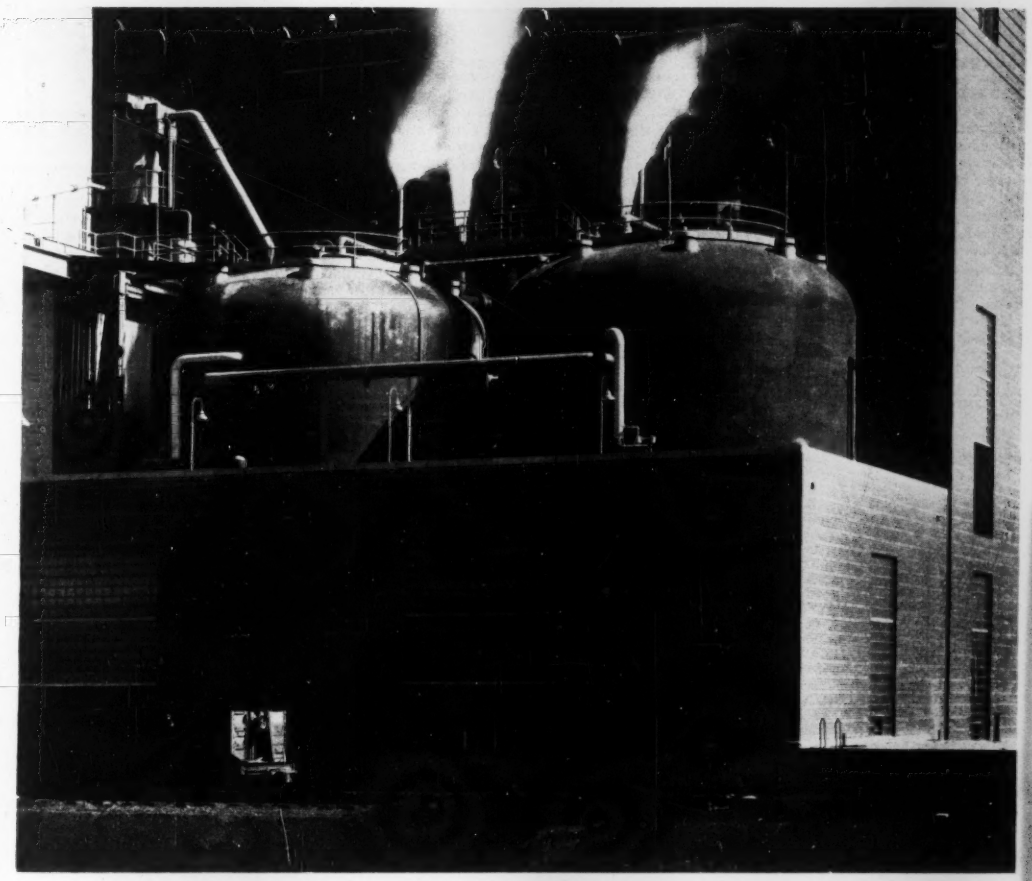
Bids for a number of projects included in a $192,000,000 Navy program for providing suitable airstrips for the latest type aircraft will be advertised during the next two months by the Navy Civil Engineer Corps. Though the major portion of the program is in the designing stage, it is expected that by the end of the year contracts will have been awarded for construction providing 31 additional Naval Air installations with runways adequate for the fastest jets and other high-speed aircraft now being built, as well as for heavy cargo planes. The projects will be spread over 15 states, with the largest at Cecil Field, and Fort Barrancas, Fla.

Navy projects under way include improvements to the Naval shore establishment in the Hampton Roads, Va., area. The major contract in the $6,500,000 program has been awarded to the Virginia Engineering Co., Inc., at Newport News, Va., for expansion of facilities at the Fleet Air Defense Training Center, Dam Neck, Va. Another large project consists of reactivation of the former Naval Advance Base Depot at Davisville, R. I., which will be the principal Naval Construction Battalion Center in the East.

Construction of the Wajawa Gulch Tunnel in Hawaii to insure an adequate water supply for Pearl Harbor and nearby Honolulu is nearing its final stages. Under construction for the past two years, this project will provide 45 mgd of fresh water daily for military and civilian personnel.

American Company Gets New Zealand Contract

A contract for building Rimutaka Tunnel on the Wellington-Wairarapa Railway in New Zealand has been awarded to Morrison-Knudsen, Ltd., of San Francisco, Calif. Construction of the tunnel, which will be 5½ miles long, is scheduled to take five years.



Two-Stage Softening Process Utilizes Horton Tanks

Pushing their heads out of the Corn Products Refining Company's power plant at Argo, Illinois, are two Horton welded steel sedimentation tanks. They were installed as part of a two-stage softening unit used to soften boiler feed water taken from city mains.

Both steps in the process involve the precipitation of sludge through heating and chemical action. Water entering the first tank is heated to 215 deg. Fahr. and subjected to a lime soda-ash treatment with a sodium aluminate adjunct. This reduces hardness to about 5 to 7 parts per million. The water is then transferred to the second tank where a disodium phosphate treatment reduces the hardness to 1 part per million. Sludge collecting in the conical bottoms of the tanks is drawn off for disposal.

These two Horton sedimentation tanks, which are identical in shape, each hold 185,000 gallons of water. There is a stirring mechanism in the top of each tank and the automatic sludge blow down valves are controlled by the raw water flow meter. Both tanks are carefully insulated so as to prevent heat loss during the softening operation.

Specialized tank construction for industry has long been a regular thing with us. Our experience enables us to tackle any steel plate fabrication problem with complete confidence. You can benefit by making use of this specialized knowledge.

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San Francisco 4.....1584—200 Bush St.
Seattle 1.....1309 Henry Bldg.
Tulsa 3.....1647 Hunt Bldg.
Washington 6.....1156 Cafritz Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

College Graduates Face Good Employment Market

University graduates this year are entering the best peace-time employment market ever known, according to Samuel H. Beach, director of placement at Columbia University. Not only do they have a greater freedom of choice than ever before, but salaries have reached a new high. To date this year, there has been a 50 percent increase in the total number of full-time job offerings over last year, according to Mr. Beach. Opportunities in the engineering field are reported up "from 200 to 300 percent, with the supply down one-third."

On the other side of the ledger, Mr. Beach reports that students are encountering a "double standard" situation in interviews with some employers. He explained that this meant only the best qualified students are being accepted for employment if they are imminently liable for military service. Small business organizations in general are not considering students who expect to be called to military duty.

Salaries are up, on the average, about $25 per month over 1950. In the technical fields, bachelor candidates are accepting offers ranging from $285 to $330 per month; master's degree candidates, from $300 to $400; and doctoral candidates, from $450 to $550.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"Shot bears charge!"

"Unh-uh, they scram!"

"Anyway, this one was white."

"Uh-huh, but white bears are just as yellow as black ones. Sometimes hunters trace their blood stains for miles."

"Not my Uncle Ben. He shot one and it chased him up a tree. He didn't come down until his partner buried the bear."

"Just a minute, Juniors," pleaded Professor Neare. "This isn't a Forum meeting, but a serious senior session to discuss Guest Professor Stoop Nagle's latest problem."

"Which involved," recalled Professor Nagle, "a new camp 146 yd south of the old one. If the bear ran 99 yd south from the old camp and then 47 yd east, how far was he, probably, from the new camp?"

"That's what we were yelling about," said Joe Kerr. "The bear was white and the old camp was at the North Pole, whence 'south' means 'any which way.' I claim the bear charged toward the hunter at the new camp C, then turned at A and ran east on an arc to B. By triggernometry, BC = 73.6 yd, the distance he was dragged."

"Unh-uh, like I said," said Mac McMack. "Unless defending mate or cub, the bear scrams, and that's more probable. So he scrammed to A', died at B', and was dragged 238 yd."

"Both wrong," claimed Ken Bridgewater. "The North Pole is only one of an infinite number of possible locations for the old camp, all the others being near the South Pole, so a south-polar setting is more probable. The first bear was chased n times around a polar circle of radius $280/n$ yd. For $n = 1$, the old camp was 2,040 yd from the pole, the bear ran 99 yd toward the new camp and east on a 1,941-yd radius to die 66 yd from the new camp. For greater n, that distance wouldn't vary by more than the semi-diameter of the bear's tail."

"Very nice," conceded Cal Klater, "except that 'antarctic' means 'as far as possible from bear country.' The truth is that the old camp was at the North Pole and we don't know which south was picked by the startled and confused bear. I figured the average distance from the new camp to all possible places the bear might have died. The answer in even feet is . . ."

"Hold it, Cal. You've found the gimmick, but, if Noah agrees, let's share that part of the problem with Joe and Mac who've been more concerned with the psychoses of bears."

"Splendid idea, Stoop. The ursal manners of the continental bear may not be the manners of his thalarctic cousin. The polar bear might run for the nearest open water like a beaver. So the next assignment is to finish the last one."

[*Cal Klaters were Richard Jenney and Flo Ridan (Charles G. Edson); Ken Bridgewater was R. E. Philleo. The Joe Kerrs outnumbered the Mac McMacks by 4 percent. Guest Professor Stoop Nagle is John L. Nagle. Also acknowledged is a nearly-on-time solution of the March canasta shuffle by A. Nuther Nutt.*]

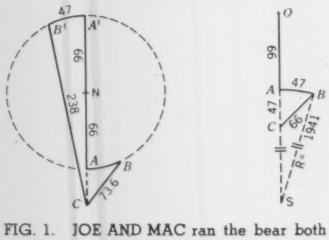


FIG. 1. JOE AND MAC ran the bear both ways from the North Pole (N), but Ken claimed he started 2,040 yd from the South Pole (S).

NEW IN EDUCATION

A half-million-dollar plan to expand the teaching and research personnel and facilities of the Georgia Institute of Technology School of Architecture has been assured with a grant of $261,500 from the trustees of the general education board, with the balance of necessary funds provided by the Institute. The expansion plan will extend over a six-year period. Major objectives of the plan are: development of outstanding graduate program in the fields of architecture; establishment of a strong program in city planning; establishment of a research program in building materials and construction methods; and the reestablishment of a program in industrial design.

* * *

Formal dedication of a new Hydrodynamics Laboratory and Ship Model Towing Tank took place at Massachusetts Institute of Technology recently, at the opening session of a symposium on "Hydrodynamics in Modern Technology." The laboratory building is the first new research facility planned and built under the M.I.T. expansion and development program.

* * *

Cornell University's new $1,700,000 center for the study of engineering materials will commemorate two faculty members, who pioneered in engineering education. One unit, a materials testing laboratory, will be named Thurston Hall, in honor of Robert H. Thurston, who was director of the Sibley School of Mechanical Engineering at the university from 1885 until his death in 1903. The other, a materials processing laboratory, will be named for Dexter S. Kimball, now in retirement, who was the first dean of the College of Engineering. Under construction as part of a long-range engineering development program, the buildings are expected to be completed in the spring of 1953.

* * *

In an attempt to step up the flow of mass-produced prefabricated housing units from factory to family by working out better methods of distribution, a year-long study will be conducted by the Cornell University Housing Research Center with a grant of $24,250 from the Federal Housing and Home Finance Agency. Under the joint direction of the Housing Research Center and the School of Business and Public Administration, the project will have the immediate purpose of making more prefabricated units available for crowded defense areas.

* * *

The name of Rhode Island State College has been changed to the University of Rhode Island by action of the general assembly of the state.

DECEASED

Frank Seymour Baillie (M. '19) for many years president of East Lawn, Inc., Sacramento, Calif., died on March 28, at the age of 81. A graduate of the University of Michigan in 1890, Mr. Baillie worked on the design of rapid transit lines from Chicago to the Jackson Park site of the World's Fair of 1893. Later he was engineer for the Gillette-Herzog Manufacturing Co., of Minneapolis, and vice-president and general manager of the Columbia Gold Mining Co. He constructed a number of ships for the Grant, Smith, Porter Co. during World War I, and in 1925 went to Sacramento as builder of the East Lawn Mausoleum.

Lytle Brown (M. '30) retired army officer and former Chief of Engineers, died at his home in Franklin, Tenn., on May 3. His age was 78. Upon his graduation from West Point in 1898, Mr. Brown was commissioned in the Corps of Engineers. He taught civil and military engineering at the academy for some time and in 1908 assumed charge of the Louisville, Ky., District office. He received the rank of colonel in 1917 and a year later was promoted to wartime brigadier general. During his career General Brown commanded many districts in this country and in the Panama Canal development, and was Chief of Engineers in Washington, D.C., from 1929 to 1933. He retired in 1936, but served in advisory capacities during the second World War.

Former ASCE Director Roy W. Crum Is Dead

Roy Winchester Crum, former ASCE Director and head of the Highway Research Board of the National Research Council in Washington, D.C., died there on May 13, at the age of 66. A graduate of Iowa State College, Mr. Crum taught civil engineering there, and later was connected with the College's Engineering Experiment Station. From 1919 to 1928 he was engineer of materials and tests for the Iowa State Highway Commission. He then became director of the Highway Research Board, serving in that capacity until the time of his death. He was chairman of the Society's Highway Division in 1932 and 1941 and ASCE Director from 1946 to 1949. He received the Iowa State College Alumni Merit Award in 1947 and later won the Marston Medal for achievement in engineering. Recently he served on President Truman's Highway Safety Conference.

Roy W. Crum

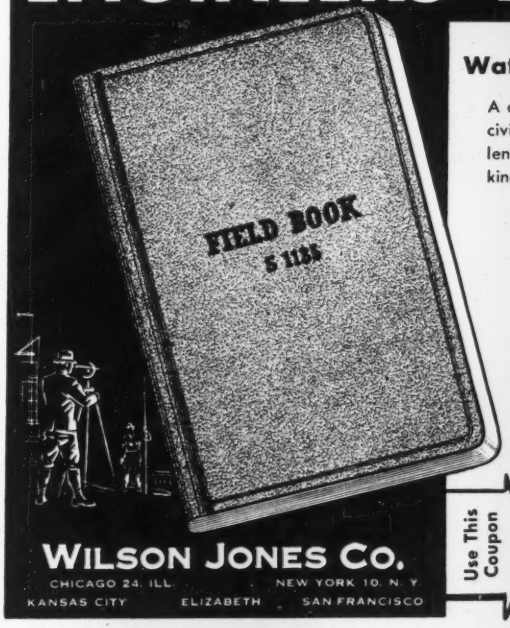
Benjamin Carl Cohen (M. '51) consulting engineer of Long Island City, N.Y., died on April 19. He was 42 and a graduate of Clarkson College of Technology. During his career Mr. Cohen was engaged in various engineering capacities by the Westinghouse Electric & Manufacturing Co., at Chicopee Falls, Mass.; the War Department, at the Springfield, Mass., Armory; and several New York consulting firms.

Harvey Girard Dimond (M. '48) for the past five years chief draftsman for the Great Northern Railway, at St. Paul, Minn., died recently. He was 58. After receiving his degree from the University of Minnesota in 1914, Mr. Dimond entered the employ of the Great Northern Railway at St. Paul, where he served successively as draftsman, assistant chief draftsman, and chief draftsman.

Peter Platter Evans (Assoc. M. '00) former president of the Osborn Engineering Co., of Cleveland, Ohio, died there on April 25, at the age of 80. He received his engineering training at Ohio State University. At the start of his career Mr. Evans worked for several Ohio railroads. In 1895 he joined the Osborn Engineering Co. as assistant engineer in charge of the construc-

(Continued on page 81)

ENGINEERS' FIELD BOOKS



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Men Available

CIVIL ENGINEER; M. ASCE; registered engineer in Florida and Michigan; over 20 years' experience in administrative positions; 15 years with Michigan State Highway Department in various capacities, including that of highway planning and contract engineer. Desires position with consulting engineer with possible partnership or construction company on salary-bonus basis. C-675.

PROJECT ENGINEER; Jun. M. ASCE; B.S.C.E.; 31; 9 years test and development experience with aircraft components, such as structural fasteners, bearings, control systems, etc. Desires permanent position in New York-Philadelphia area. C-677.

ENGINEER; Jun. M. ASCE; 26; structural engineering graduate; desires to teach undergraduate course in civil engineering; some experience in design and in field work. Interested in teaching as life's work. Desires position in New York metropolitan area. C-679.

CIVIL ENGINEER; Assoc. M. ASCE; registered engineer, New York State; B.C.E., Cornell University; 31; 5 years varied construction experience, foreign and domestic, including harbor, dam, foundation, and earth-moving—both field and administration, 3 years industrial administration. Prefers either East or foreign heavy construction. C-680.

CIVIL ENGINEER; Jun. M. ASCE; graduate; professional engineer, New York State; veteran, married; 2 years with concrete sub-contractor estimating, detailing, and field supervision; 1½ years assistant construction superintendent for general contractor; 1 year structural design; 1 year detailing and estimating for structural steel fabricator. C-681.

CIVIL ENGINEER; Jun. M. ASCE; licensed, graduate; 30; 1 year Bureau of Reclamation, 2 years highway surveys; 2½ years as estimator-engineer for general contractors; 3 years naval construction and repair. Desires position in Southeast United States. C-682.

CIVIL ENGINEER; Jun. M. ASCE; 28; married; B.S.C.E., M.C.E. (structures); registered professional engineer; 5 years' varied experience including structural design, teaching experience in civil engineering and engineering mechanics, supervision of construction inspectors, reports, layout and surveys, administration and correspondence, structural drafting, and detailing. C-683.

CIVIL, structural and architectural engineer; M. ASCE; 36; married; registered engineer, several states; degrees, B.S.C.E., and C.E.; 12 years' experience in design and construction supervision of industrial, institutional and public buildings, plus office administration; presently employed as chief engineer. Desires permanent, responsible position with consulting engineering firm, preferably in the Northeast. C-684.

YOUNG ENGINEER; Jun. M. ASCE; with B.C.E. degree and construction layout and inspection experience on 2½ million dollar pumping plant for large city, desires permanent position in East to layout, inspect construction, and supervise the operation of municipal water-supply project. C-685.

Positions Available

ESTIMATORS, two, for general construction work including building structures, but not including road work or marine jobs. (*a*) One experienced not only in regard to quantities for lump sum bidding, but also with some experience in pricing. (*b*) One capable of arriving at a proper list of quantities for pricing, but not necessarily qualified to price a bid. Salaries open. Location, New England—headquarters, Rhode Island. Y-5210.

PLANNING TECHNICIANS, graduates from recognized college or university with major work in city planning, civil engineering, architecture, landscape architecture, or other related acceptable field, for work including map delineations, preparation of base maps, charts, graphs, statistical research, field surveys of blighted areas, miscellaneous city planning, and redevelopment work. Location, Westchester County, New York. Y-5245.

SURVEYOR ENGINEER, civil graduate, or non-graduate thoroughly familiar with plane surveying. Must have ability to make all necessary computations as well as to perform the actual field work. Experience in the tropics preferred. Single status for six months. Draft exempt. Salary, $4,560 a year, plus maintenance while in the field camp and $60 a month bonus. Location, Colombia, South America. Y-5248.

SEWERAGE ENGINEERS OR WATER WORKS ENGINEERS for assignments abroad in connection with housing and community development. Must be United States citizens, requiring security clearance. Salaries open. Headquarters, Washington, D.C. Y-5256.

CIVIL OR SANITARY ENGINEER with 2 or more years' experience in the design of municipal and industrial sanitary engineering projects. Salary dependent on qualifications. State salary desired. Location, Ohio. Y-5315.

CIVIL ENGINEER for design work on park and parkway development, with 5 years' general design experience in minor structures, utilities and roads, with some field experience desired. Location, Michigan. Y-5316.

FIELD ENGINEER, civil graduate, with considerable cement aggregate and general concrete testing experience, to be responsible for selection of ingredients, preparation, mixing, and placing concrete form set-up and reinforcement. Salary, $7,800 a year, including subsistence and quarters. Location, eastern Canada. Y-5335.

TEACHING PERSONNEL. (*a*) Instructor, with master's degree, preferably with teaching, and some practical experience, to teach surveying and mechanics. (*b*) Assistant professor with master's degree and teaching experience, to teach reinforced concrete, structural design, and construction. Position starts September 1951. Location, upstate New York. Y-5350.

ENGINEERS. (*a*) Technical consultant preferably civil or mining graduate, with some experience in magnesium plant operation for government contract on remodeling magnesium plants. (*b*) General civil engineer, not over 45, for general contractor's office, with considerable experience in estimating, purchasing and correlating several construction projects. Salary, $7,800 a year. Location, Ohio. Y-5383.

CIVIL ENGINEER, young, with some experience in testing materials for research project on reinforced concrete. Salary, $4,000–$4,500 a year. Location, Washington, D.C. Y-5388.

RIGGING SUPERVISOR with mechanical or civil engineering training and at least 5 years' machinery, piping, structural and process equipment installation and erection experience, to take charge of erection of oil refining and processing equipment. Some traveling. Salary, $7,800 a year. Headquarters, New York, N.Y. Y-5391.

ENGINEERS. (*a*) Assistant field engineer, with several years construction experience, to assist construction superintendent on airport project. Salary, $7,280 a year, plus subsistence. One-year contract. (*b*) Assistant purchasing agent who has had experience on construction materials such as timber, cement, sand, brick, etc. Salary, $5,980 a year, plus subsistence. One-year contract. Location, foreign. Y-5392.

CIVIL ENGINEER, graduate, with 3 years' experience in construction work for a sugar mill. Salary open. Location, Puerto Rico. Y-5441.

CIVIL ENGINEER, thorough knowledge of and training in hydraulics. Hydraulics design experience in connection with dams and pipe lines. Location, Connecticut. Y-5520.

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(*Continued from page 79*)

tion of the Chagrin River Bridge, and later was associated with the King Bridge Co., Boston, Mass. Returning to the Osborn organization in 1900, he successively became contracting engineer, secretary, vice-president, and president before retiring in 1943.

Elmer Leroy Ferguson (Assoc. M. '23) for many years chief of the engineering section of Region 5 of the Federal Works Agency, at Fort Worth, Tex., died recently. His age was 63. Earlier Mr. Ferguson was drainage engineer for C. Moriarty, civil engineer of Sioux City, Iowa; engineer for Ward & Taylor, Sioux City contractor; and drainage engineer for the Clark E. Jacoby Engineering Co. of Kansas City, Mo. From 1924 to 1928 he served as sanitary and hydraulic engineer for the Burns-McDonnell-Smith Engineering Co. in Kansas City, Mo., and Los Angeles, Calif. Later he was with the Public Works Administration and the Brown-Bellows-Columbia contracting firm. He also engaged in private practice. He attended the University of North Dakota and Iowa State College.

Lewis E. Johnson (M. '01) retired engineer of West Palm Beach, Fla., died there on March 18, at the age of 86. He received his education at the Massachusetts Institute of Technology. From 1907 to 1916 he designed and estimated bridges for the Bethlehem Steel Co., and from 1916 until his retirement in 1922 he was assistant superintendent of the Bridge Department of the Bethlehem Steel Co. His projects included design of the Gokteik viaduct in Burma on the railroad that connects with the Burma Road.

Owen Merriwether Jones (M. '13) chief engineer in the electro metallurgical division of the Union Carbide & Carbon Corp., at Glen Ferris, W. Va., died there on April 7. His age was 73. At the beginning of his career Mr. Jones taught engineering at Syracuse and Tulane universities; served as vice-president of the Michigan Northern Power Co.; and was designing and supervising engineer in the Hawk's Nest hydroelectric power development and the Alloy steam electric station. From 1911 on he was connected with the Union Carbide Co. He was a Vanderbilt University graduate.

Alfred Julius Krafft (Assoc. M. '12) consulting and designing structural engineer in San Francisco, Calif., died on February 17, 1950, though word of his death has just reached Society Headquarters. He was 70. Mr. Krafft was first employed by Purdy & Henderson, civil engineers of Boston, Mass. For many years he had been a member of the engineering firm of J. E. Krafft & Sons. He was educated at the University of California and Massachusetts Institute of Technology.

Charles Ernest Legris (M. '36) of Roberval, Quebec, Canada, died on October 2, 1950, though notice of his death has just been received. He was 63. Of recent years Mr. Legris had been construction engineer for the Public Buildings Administration of the Federal Works Agency in Washington, D.C. Before that he was field engineer on several hydroelectric power developments in North Carolina; resident engineer for the Aluminum Company of Canada, at Arvida; and on flood control work for the Corps of Engineers in the Kansas City and St. Louis, Mo., districts. He was a McGill University graduate.

Harry Deyoe McGlashan (M. '17) retired district engineer of the Water Resources Branch of the U. S. Geological Survey, at San Francisco, Calif., died there on March 26, at the age of 72. An authority in the hydraulic engineering field, Mr. McGlashan had served with the San Francisco Water Resources Branch from 1906 until his retirement in 1949. He graduated from Syracuse University.

Howard Chester Means (M. '23) of Salt Lake City, Utah, died there on March 20, at the age of 75. Upon his graduation from the University of Illinois, Mr. Means entered the employ of the U. S. Indian Service. He did engineering work on the irrigation systems of Crow and Cheyenne Reservations in Montana, the Shoshone Reservation in Wyoming, and the Uintah Reservation in Utah. Later he became chief engineer for the Utah State Road Commission and manager and engineer for the Utah Rock Asphalt Co.

Henry Rupert John Meyer (Assoc. M. '21) engineer for the St. Louis Water Di-

(*Continued on page 82*)

Project PR-3

Government of Puerto Rico
Department of the Interior
Bureau of Buildings
Santurce, P. R.

Date: May 15, 1951

ADVERTISEMENT

Sealed proposal will be received by the Commissioner of the Interior of Puerto Rico, at the office of the Board of Awards, Department of the Interior, Santurce, Puerto Rico, until 2:00 P.M. on *September 14, 1951*, and then be publicly opened and read aloud, for furnishing all plant, labor, and materials and performing all work required for the *CONSTRUCTION OF THE GENERAL DISTRICT HOSPITAL BUILDING, PONCE HOSPITAL CENTER, PONCE, PUERTO RICO.*

Plans, specifications, and all pertinent contract documents may be obtained at:

1. **Board of Awards, Department of the Interior, Santurce, Puerto Rico**
2. **Office of Isadore Rosenfield, Architect, 23 West 47th Street, New York 19, N. Y.**

from the date of this advertisement until (15) calendar days before the date for opening bids, upon deposit in cash, money order, or certified check payable to the Commissioner of the Interior of Puerto Rico in the amount of *TWO HUNDRED FIFTY DOLLARS ($250.00).*

The full amount of this deposit will be refunded to the depositor upon return of the above documents in good condition within a period of *THIRTY (30) DAYS* after the date of the opening of bids.

Each proposal must be accompanied by a provisional bond in cash, bid bond, or certified check payable to the Commissioner of the Interior of Puerto Rico for not less than SIXTY THOUSAND DOLLARS ($60,000.00).

Special attention is called to the bidders that any bid which does not contain the prices written in letters and figures will be rejected, and that the Board of Awards reserves the right to reject any or all bids and to waive informalities.

Engineer's Estimate $3,000,000.00.

JORGE J. JIMENEZ
Commissioner

Deceased

(Continued from page 81)

vision, St. Louis, Mo., died on October 21, 1950, according to word just received. His age was 67. Mr. Meyer began his career with the U.S. Reclamation Service on the Milk River project in Montana. Subsequently, he was engaged by the Corrugated Bar Co., at Buffalo, N.Y.; the Warrenton County (Missouri) engineer; and Swearingen & McCulloh, consulting engineers of Great Falls, Mont. He received his engineering degrees from the University of Missouri and Cornell University.

Alan G. Mills (Assoc. M. '37) architectural engineer for the Southwestern Bell Telephone Co., with headquarters in Oklahoma City, Okla., died on February 21. Except for a six-month period as draftsman for the American Railway Express Co., Mr. Mills was employed by James Stewart & Co., contractors, from 1916 to 1921. He then became engineer on valuation work for the Missouri Pacific Railroad in St. Louis. In 1923 he joined the Southwestern Bell Telephone Co., becoming architectural engineer in 1927.

Alfred Neuffer (Assoc. M. '24) since 1932 contracting manager of the Los Angeles, Calif., district of the Bethlehem Pacific Coast Steel Corp., died recently, at the age of 53. He was a graduate of the University of Cincinnati. Earlier Mr. Neuffer served as contracting engineer for the McClintic Marshall Corp. in their New York and Philadelphia offices. He was also engaged as assistant professor in civil engineering at the University of Hawaii.

Blair Arthur Ross (M. '24) former national parks superintendent and retired army engineer officer, died at Jackson, Tenn., on April 30, at the age of 62. He was a University of Missouri graduate, class of 1912. With the Corps of Engineers for 27 years, Mr. Ross did flood control work along the Mississippi River. In 1939 he became superintendent of Shiloh National Park and Smoky Mountain National Park. He retired in January 1950 and moved to Jackson, where he made his residence.

Arthur Truman Safford (M. '99) consulting engineer for the Proprietors of Locks & Canals Co., of Lowell, Mass., died there on April 3. He was 83. Earlier Mr. Safford was affiliated with the Metropolitan District Water Supply Commission in Boston, Mass., and was engineer in the New England office of the Federal Fuel Conservation Agency. He had been associated with the Locks & Canal Co. for over 50 years. He was educated at Williams College.

William Hatfield Sears (M. '19) Chattanooga, Tenn., architect, died there on April 19, at the age of 76. He was a graduate of the Columbia University College of Architecture. Mr. Sears went to Chattanooga in 1907 and became an associate in the R. H. Hunt Co. Later he formed a partnership under the firm name of Huntington & Sears and in 1911 established his own company. For some time he was connected with Percy Shepherd. He served as a member of the Tennessee Board of Architectural and Engineering Examiners for 27 years.

NEWS OF ENGINEERS

L. N. McClellan

L. N. McClellan, chief engineer and director of Bureau of Reclamation's Branch of Design and Construction in Denver, Colo., was awarded a gold medal by the Colorado Engineering Council at April 18 meeting. Called highest tribute of engineering profession in Colorado for personal engineering accomplishment, medal has been presented only four times previously since its inception in 1930.

Clifton E. Hickok has retired as principal administrative analyst for the FPHA at San Francisco after approximately 20 years of government service. During his career Mr. Hickok has served as chief engineer and assistant state director in the San Francisco office of the Public Works Administration; senior public works engineer for the National Resources Planning Board, at Portland, Oreg., and Berkeley, Calif.; and maintenance engineer for the Public Housing Administration in San Francisco. He has also been city engineer and city manager for Alameda, Calif.

Frank C. Wardwell, for the past eleven years project manager and general superintendent for Stone & Webster Engineering Corp., in the Chicago, Ill., area, has been transferred to Seven Islands, Quebec, Canada. Mr. Wardwell will represent Stone & Webster, Sanderson & Porter, and Coverdale & Colpitts, consultants to the Iron Ore Company of Canada on the construction of the Quebec, North Shore & Labrador Railway—a 357-mile main line railway between Seven Islands, Quebec; and its northern terminus at Knob Lake, Labrador.

Leslie W. Bolman is now engineer on heavy construction for the Shanahan Construction Co., at Ellenville, N.Y. Previously Mr. Bollman was section engineer on the East Delaware Tunnel for the New York City Board of Water Supply.

B. Everett Beavin, Sr., formerly an associate in the engineering firm of J. E. Greiner Co., with headquarters in Baltimore, Md., has established his own professional engineering practice at Linthicum Heights, Md.

Arthur R. Baylis recently retired as engineer of design for the Hudson & Manhattan Railroad Co., New York, N.Y. He will make his residence in Peeskill, N.Y.

John M. Griffith, who has been chief of the bituminous and chemical section of the Flexible Pavement Branch at the Corps of Engineers' Waterways Experiment Station in Vicksburg, Miss., has been appointed engineer of research for the Asphalt Institute, with headquarters in New York City.

(*Continued on page 84*)

Meetings and Conferences

American Institute of Electrical Engineers. Headquarters for the summer meeting of the American Institute of Electrical Engineers will be Toronto, Canada, June 25–29.

American Society for Engineering Education. A diversified program is scheduled for the annual meeting of the American Society for Engineering Education, including the Engineering College Administrative Council and the Engineering College Research Council, at Michigan State College, East Lansing, Mich., June 25–29.

American Society of Heating and Ventilating Engineers. The semiannual meeting of the American Society of Heating and Ventilating Engineers will take place in Portland, Oreg., July 2–4.

American Society of Mechanical Engineers. Technical sessions, excursions, and social functions are scheduled for the semiannual meeting of the American Society of Mechanical Engineers, at the Royal York Hotel, Toronto, Canada, June 11–14. The twenty-third annual conference and exhibit of the oil and gas power division of ASME will be held at the Baker Hotel, in Dallas, Tex., June 25–29.

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News of Engineers

(*Continued from page 83*)

Sigvald Johannesson, for many years New Jersey State Highway Department director of planning, traffic, and economics, has been granted an honorary doctor of engineering degree from the University of Denmark "in appreciation of his accomplishments in relation to public works and of his literary engineering achievements." He is the author of *Highway Economics*.

John R. Hardin, division engineer of the Great Lakes Division of the Corps of Engineers, at Chicago, and **John S. Seybold,** South Pacific division engineer, at San Francisco, have been ordered to duty in the Office of the Chief of Engineers, with headquarters in Washington, D.C. Colonel Hardin will be succeeded by **Col. William P. Trower,** who has been serving as chief of the Chicago Procurement Office of the Corps, and Colonel Seybold by **Col. Donald S. Burns,** formerly district engineer, at Portland, Oreg.

Damon Runyan, consulting engineer, has opened his main office at 1111 Stout Street, Denver, Colo., with a suburban office at 8592 West Colfax Avenue, Lakewood, Ohio.

Thomas M. Davis has retired as senior highway engineer for the U.S. Public Roads Administration, at Portland, Oreg., after 31 years of government service.

Werner H. Gumpertz, previously consultant to the Massachusetts Commission on the structure of the state government, has

Werner Gumpertz

accepted the position of assistant professor in the department of building engineering and construction at Massachusetts Institute of Technology. During the recent war Mr. Gumpertz served in the Army Intelligence Service and was in the European theater for three years. He has also been structural engineer in the Office of the Chief Engineer, EUCOM, and has been engaged in construction engineering work in New York, Virginia, and Washington.

C. Ken Weidner was recently appointed dean of the new school of engineering of the American University of Beirut, Beirut, Lebanon. Previously Mr. Weidner served as representative of the University of Chicago in charge of the construction of the Argonne Laboratories.

Bernard R. Bogan, who has been engaged in civil engineering work in the Houston-Austin, Tex., area for the past 14 years, has joined the staff of H. E. Bovay, Jr., Houston consultants.

G. W. Bradshaw, chairman of the department of civil engineering, at the University of Kansas, was recently elected to the City Commission of Lawrence, Kans.

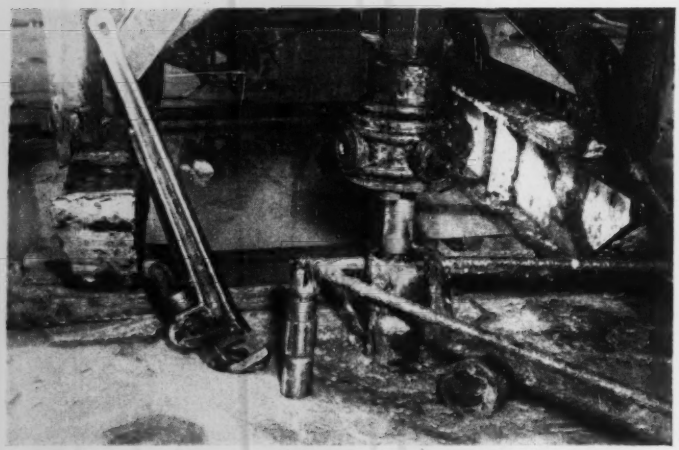
J. R. Tanner, John A. Langan, and **Kenneth R. Brown** are now associates in the consulting firm of O'Brien & Gere of Syracuse, N.Y.

Donald P. Roberts, previously connected with Frederick R. Harris Engineers, Inc., is now affiliated with the Harza Engineering Co., with headquarters in Chicago, Ill.

Brandon H. Backlund announces the establishment of a civil engineering practice, with offices at 5225 Kansas Avenue, Omaha, Nebr., specializing in structural design.

Richard V. Hyland, of the New York consulting firm of Madigan-Hyland, was elected president of The Moles, New York society of heavy construction men, at the organization's recent annual meeting in New York City. He succeeds **James F. Salmon,** New York manager of Arundel Corp. The new roster of officers elected includes **David Bonner,** Frederick Snare Corp., first vice-president; **ASCE Past-President R. E. Dougherty,** New York consultant, second vice-president; **George P. Walker,** Johns-Manville Corp., secretary; and **H. P. Maxton,** Raymond Concrete Pile Co., treasurer. **J. E. Gibbons,** American Surety Co., was elected a trustee for a three-year term.

Richard V. Hyland



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Diamond drillers, drilling Ax, Bx and Nx grout holes through rough fossiliferous Tampa limestone and heavy shale at a Chattahoochee River dam site, were having slow going . . . bit costs were high. Rough formation damaged diamond bits and was too hard for other bits.

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William Allan, dean of School of Technology, City College of New York, has been elected president of the Association of Engineering Colleges of New York State. Dean Allan has been at City College since 1933 and has been professor of civil engineering and dean of the Technology School since 1947. An authority in hydraulics research, he was co-winner two years ago of the Norman Medal of the ASCE and last year won the J. C. Stevens Award for his discussion of the paper, "Panama Canal—The Sea-Level Project: a Symposium."

William Allan

Carl E. Green announces the establishment of Carl E. Green & Associates, consulting engineers, with offices at 510 Henry Building, Portland, Oreg. The firm will specialize in civil, hydraulic, and sanitary engineering. Formerly he was consulting engineer for Cunningham & Associates in Portland.

Downing B. Jenks, assistant vice-president and general manager of operations for the Chicago, Rock Island & Pacific Railroad, Chicago, Ill., recently received the Yale Engineering Association's award for achievement in basic and applied science. He was cited "as an engineering executive upholding the best traditions of Yale's Industrial Administration Department."

Richard Hazen, formerly a partner in the consulting concern of Malcolm Pirnie Engineers, New York City, announces the opening of a consulting office in New York for the practice of municipal and industrial engineering. He will be located at 110 East 42nd Street.

Carl C. Walker, for some years chief engineer for the Jennings-Lawrence Co., of Columbus, Ohio, is now president and chief engineer.

David W. Godat, New Orleans, La., consultant, has been appointed to the City Planning and Zoning Commission of that city.

Harry P. Hammond, since 1937 dean of the Pennsylvania State College School of Engineering, will retire with emeritus status on September 1. Prior to his appointment at Penn State, Dean Hammond served on the faculties of the University of Pennsylvania, Lehigh University, and at Polytechnic Institute of Brooklyn. He will be succeeded by **Dr. Eric A. Walker,** director of the Ordnance Research Laboratory and professor and head of the department of electrical engineering at the college.

Harry P. Hammond

(*Continued on page 86*)

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Dept. 18, Burbank, California

News of Engineers

(*Continued from page 85*)

Kenneth C. Roberts has joined the consulting firm of Palmer & Baker, at Mobile, Ala. He was formerly a partner in the Vern E. Alden Co., Chicago.

Ralph N. Brescia has been recalled to active duty in the Civil Engineer Corps of the Navy as assistant resident officer in charge of construction on the new permanent hospital facilities at the U.S. Naval Hospital, St. Albans, N.Y.

P. E. Borchers, engineering chief of the water supply section in the Repair and Utilities Division of the Corps of Engineers, Washington, D. C., has retired.

Van Rensselaer P. Saxe announces that his office is now located at 1701 St. Paul Street, Baltimore, Md.

Arthur A. Collard, until recently head of the department of civil engineering at Rhode Island State College, Kingston, has joined the engineering staff of Knappen Tippetts Abbett Engineering Co., in New York City.

Karl R. Kennison, consulting civil and hydraulic engineer, of Waban, Mass., has accepted an appointment as lecturer in civil and sanitary engineering at the Massachusetts Institute of Technology. For many years Mr. Kennison was chief engineer of the Metropolitan District Commission in Boston.

M. E. Wegenstein, Zurich, Switzerland, consulting engineer on water supply and sewage treatment, has been appointed member of a three-man committee, which is in charge of the planning and development of a water supply for Barcelona, Spain, that will serve 1,500,000 inhabitants. The Jugo-Slav Government has asked Mr. Wegenstein to supervise the construction of several Ranney-Collectors for the city of Belgrad. This new system of tapping ground-water streams was developed in the United States by Ranney Method Water Supplies Inc., Columbus, Ohio, with which Mr. Wegenstein is connected.

M. E. Wegenstein

James L. Lane, formerly engineer on the staff of the Idarado Mining Co., at Ouray, Colo., is now serving as construction engineer for the Regional Post Engineer, Yokohama Command, Yokohama, Japan. Lieutenant Lane has been on active duty since last November.

Richard C. Clark, previously associate editor of *Western Construction News*, San Francisco, Calif., has become connected with the Clay Brick & Tile Association, with headquarters in San Francisco.

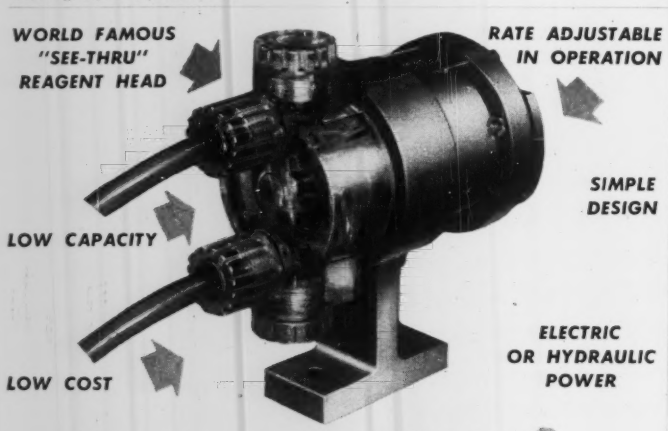
Forrest Nagler, chief mechanical engineer for the Allis-Chalmers Manufacturing Co., at Milwaukee, Wis., and **N. T. Veatch,** partner in the Kansas City, Mo., consulting firm of Black & Veatch, have been honored by the election to the ASME grade of fellow—which means 25 years of active practice in the profession.

Charles H. Norris has been promoted from associate professor of civil engineering at the Massachusetts Institute of Technology to full professor. Other faculty promotions included **Harl P. Aldrich,** formerly instructor in civil engineering, and **Henry M. Paynter,** previously teaching assistant in civil engineering, to assistant professors.

Ward Hall, supervising transportation engineer for the California State Public Utilities Commission, San Francisco, has retired after 34 years on the staff.

Theodore K. Rothermund has been named chief engineer of design and construction in the project design division of W. W. Slocum & Co., with headquarters at No. 1 Clinton Street, Newark, N.J. Formerly Mr. Rothermund was vice-president for Devenco Inc., of New York City.

Raymond Jennings Ivy, secretary-treasurer of the Sacramento Section and associate bridge engineer for the California State Division of Highways at Sacramento, has been ordered to active duty in the Civil Engineer Corps of the Navy. He expects to be stationed in the Aleutian Islands. **Ralph Hutchinson,** senior bridge engineer for the state, will succeed him as secretary-treasurer of the Section.



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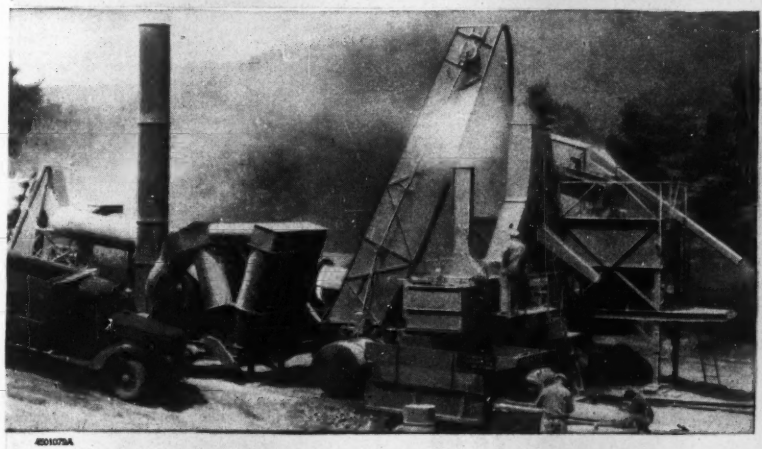

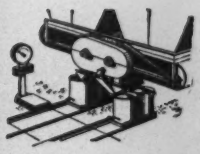

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New Publications

Highway Administration. In *Effective Administration in State-City Highway Activity*, Norman Hebden sets forth criteria of sound administration necessary to the initiation of a comprehensive policy of state-city relationships in highway work. Matters of organization, perspective, programming, uniform policies, standards, administrative supervision, communications, responsibility and authority are dealt with. Copies are $2 each and may be obtained from the Yale Bureau of Highway Traffic, Strathcona Hall, New Haven, Conn.

Virginia Highways. The forty-third annual report of the Virginia State Highway Commission for July 1949 to June 1950 is now available. Inquiries should be addressed to the State Highway Commission of Virginia, Department of Highways, Richmond, Va.

Water Resources. The Illinois Department of Public Works and Buildings, Division of Waterways, in cooperation with the U.S. Geological Survey, reports on *Water-Supply Characteristics of Illinois Streams*. Based on interpretative studies of records for 28 stream-flow gaging stations, the volume discusses long-term flow characteristics of Illinois streams and new methods and techniques of interpreting. Copies may be obtained by request to the Division of Waterways, Springfield, or the U.S. Geological Survey, Champaign, Ill.

Soil Mechanics. The Institution of Civil Engineers has taken over publication of *Géotechnique*, a magazine devoted to soil mechanics. The articles on engineering geology are international in character; contributions coming from various countries. Beginning in 1952 the magazine formerly issued twice a year will become a quarterly, the subscription rate remaining unchanged at £1 per annum. A subscription blank may be secured by writing to the Secretary, The Institution of Civil Engineers, Great George Street, London, S.W.1.

2
1
3
3-purpose part. Ingenious design is a feature of Mathews Hydrants—for example, use of a shield operating nut of high tensile iron. This serves three purposes.
1 It protects the soft bronze revolving nut from wrench wear.
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Regional Planning. A descriptive and statistical account of activities and functions of the Los Angeles County Regional Planning Commission for the fiscal year ending June 30, 1950, are given in the organization's current annual report. Personnel organization charts, pictorial maps, and workload charts are included to illustrate specific topics. Information is available from the Regional Planning Commission, 108 W. Second St., Los Angeles 12, Calif.

Civil Defense. A definite program for New York City's civilian defense requirements, and a suggested means of financing the program to serve as a basis for discussion with federal and state officials is presented in the booklet, *New York City, Civil Defense*. Address all inquiries to Arthur W. Wallander, Director of Civil Defense, New York, N.Y.

Snow Investigations. Cooperative snow investigations of the Army and Commerce Departments, the Weather Bureau, and the Corps of Engineers, are described in Technical Report No. 6-4 of the Corps of Engineers, entitled *Progress Report, 1945-1950*. For information address the Program Director, Oakland Army Base, Oakland, Calif.

Expressway Design. Studies of the Philadelphia City Planning Commission for the development of the Schuylkill Expressway and extensions are issued in *The Preliminary Report for the Schuylkill Expressway*. The report, largely graphic, may be obtained by applying to the City Planning Commission, Market St., National Bank Building, Philadelphia, Pa.

Central Montana Maps. A geological map showing the location, size, and shape of five anticlines and domes in a possible oil-producing area of about 500 square miles near the geographic center of Montana has been published by the Geological Survey of the Department of the Interior. The map, titled *Geology of the Button Butte-Forestgrove Area, Montana*, may be purchased from the Distribution Section, Geological Survey, Denver Federal Center, Denver, Colo., or Room 1210 General Services Building, Washington, D.C., at 60 cents each.

Concrete Specifications. Revised specifications for concrete pavement construction, approved by the American Association of State Highway Officials, July 31, 1950, are now available. A subcommittee of the Committee on Construction composed of J. J. Corbett, Scott Barber, O. L. Methoven, and H. G. Smith undertook the revisions. Further information is available from the General Offices of the AASHO, 917 National Press Building, Washington, D.C.

Improved Nails. A Bulletin of the Engineering Experiment Station at Virginia Polytechnic Institute, entitled *Improved Nails for Building Construction*, describes investigations performed in the Wood Research Laboratory, under the supervision of E. George Stern, Research Professor. Without exception, according to the report, the tested grooved nails are superior in holding capacity to the corresponding plain-shank nails. The bulletin may be purchased for 25 cents from the Virginia Engineering Experiment Station, Virginia Polytechnic Institute.

Construction Industry. Two subjects on the agenda of the third session of the Building, Civil Engineering and Public Works Committee of the International Labor Organization, held recently in Geneva, are discussed in Reports II and III currently being made available by the organization. The reports are entitled *Welfare in the Construction Industry* and *Seasonal Unemployemnt in the Construction Industry*. Inquiries about the reports should be sent to the International Labor Office, Geneva, Switzerland.

Steel Reinforcing Bars. The Commodity Standards Division of the Office of Industry and Commerce, U.S. Department of Commerce, reports the availability of *Simplified Practice Recommendation R26-50, Steel Reinforcing Bars*. This recommendation, which covers the standard sizes of steel reinforcing bars, was first issued in 1925. Present changes were suggested by the Committee on Reinforced Concrete Research of the American Iron and Steel Institute. Printed copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at 5 cents per copy. A discount of 25 percent will be allowed on orders for 100 or more copies.

New Publications

Professional Examinations. Surveying questions used at six engineering colleges by the writer and his colleagues, and selected from the Civil Service and professional registration examinations given in six states comprise a mimeographed volume entitled 1313 *Review Questions for Surveyors*. Questions are of various types—multiple choice, discussion, completion, true-and-false and problems. Answers are given for 580 questions. Copies are obtainable postpaid from R. C. Brinker, Box 323, Blacksburg, Va., for $2.

Concrete Pipe Research. *The Concrete Handbook* prepared by the American Concrete Pipe Association contains engineering data and technical information on concrete pipe, collected for the first time in one volume. Single copies are available to engineers and consumers through the American Pipe Association, 228 North La Salle St., Chicago, Ill., at $4 per copy, or from local concrete pipe manufacturers.

Foreign Study Opportunities. More than 30,600 foreign study opportunities for 1950–1951, available from donors in 54 countries, are reported in UNESCO'S new edition of *Study Abroad*, an international handbook of fellowships, scholarships and study grants. Copies of volume III of *Study Abroad* are on sale at the Columbia University Press, 2960 Broadway, New York City, at $1.25 each.

Urban Development. An authoritative analysis of past and present experience in benefit district financing as applied to parking is presented in Technical Bulletin No. 15 of the Urban Land Institute, entitled *Special or Benefit Assessments for Parking Facilities*. Prepared especially for the Institute by David R. Levin, chief of the Land Studies Section of the Bureau of Public Roads, the bulletin is based on extensive research which the Bureau has been conducting in the field of automobile off-street parking. It covers in detail such aspects as enabling legislation, financing provisions, methods of assessment, court cases, and current operating experience. Copies may be obtained from the Urban Land Institute, 1737 K Street, N.W., Washington 6, D.C., for $1.50 each.

Geodetic Triangulation. Specifications, instruments, and methods of triangulation field operation of the U.S. Coast and Geodetic Survey are described in its Special Publication No. 247, entitled *Manual of Geodetic Triangulation*. Recent progress in the development of instruments, equipment and methods have made this new manual necessary as a replacement for older manuals. Copies are available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at $1.50 each.

Highway Report. In the Fifteenth Biennial Report on Vermont Highways for 1949–1950, the State Highway Board estimates that increased state revenue totaling over $3,000,000 will be required in the next two years for matching federal funds. Specific recommendations for changes in the Vermont statutes are suggested, and information about the progress in highway construction is included. Inquiries should be sent to the State Highway Board, Montpelier, Vt.

Dictionary of Dams. Under the sponsorship of UNESCO, the International Commission on Large Dams of the World Power Conferences presents the first edition of its technical and illustrated dictionary, *Dictionnaire Technique Des Barrages*, limited to the French, English (British and American versions) and German translations. The original framework in the French language was established by the French Committee on Large Dams. Divided into four categories—General, Dams, Appurtenant Works, and Construction Works, the terms may be located in the alphabetical index. Further information may be obtained from the Bureau Central De La C.I.G.B., 3 rue de Messine, Paris VIII, France.

Highway Research. Highway Research Board tests, made on a homogenous clayey-silt section containing 37 earth pressure cells and five deflection gages and reported at the 29th annual meeting of the Board, are described in Research Report No. 12-F, entitled *Stress Distribution in a Homogenous Soil*. Inquiries should be directed to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

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RECENT BOOKS

Building Estimator's Reference Book
Vest-Pocket Estimator

Comprehensive information and detailed cost figures for the estimating of all classes of modern buildings are provided in the eleventh edition of the *Building Estimator's Reference Book* by F. R. Walker. The present edition, which is completely revised and rewritten with much new material added, includes the *Vest Pocket Estimator*.

Not for sale separately, the *Vest-Pocket Estimator* contains in tabular form material quantities and labor hours for estimating the cost of all classes of building construction. (Frank R. Walker Co., 173 West Madison St., Chicago 2, Ill., 1950. 1,780 and 220 pages, respectively. $12.)

City Planning, a Selection of Readings in Its Theory and Practice.

A collection of studies, essays, or excerpts from books on various aspects of city planning, including the nature of urban problems, the development of American planning, housing, and the technics of planning is given in this volume, prepared by the faculty in City Planning at the University of Minnesota. Some special planning documents, such as the Housing Act of 1949, are also presented. (Burgess Publishing Co., 426 So. 6th St., Minneapolis 15, Minn., 1950. 226 pages, $3.75.)

Geodäsie und Photogrammetrie. Teil I. Instrumente und Verfahren der Vermessung und Graphisch-Mechanischen Auswertung.

Written for the practicing engineer as well as for students, this volume by F. Ackerl is the first of a series on geodesy and photogrammetry. It considers the instruments and measuring procedures used in the field as well as graphical-mechanical evaluation methods. The characteristics and applications of typical instruments are discussed in considerable detail. A bibliography is given at the end of each chapter. (Verlag Georg Fromme & Co., Vienna, 1950. 460 pages, $6.50.)

Grund- und Wasserbau in Praktischen Beispielen

This second volume, *Grund- und Wasserbau in Praktischen Beispielen* by O. Streck, of a two-volume set treats different conditions of water flow. It provides, in addition to theoretical principles, various examples of flow in non-pressure and pressure piping, of surges and suction waves, vibratory movements, weirs, bridge dams, irrigation, and water removal. It is written in the form of problems with detailed solutions that include designs, sketches, tables, and cost analyses. (Springer-Verlag, Berlin, Göttingen, Heidelberg, 1950. 700 pages, 45 D.M.)

Handbuch der Holzkonservierung

The science and practice of wood preservation and protection are covered in the third edition of *Handbuch der Holzkonservierung*, by Mahlke and Troschel and edited by J. Liese. The major sections deal with the characteristics of untreated wood, various damaging section agents, protection of wood, examination of protecting substances (including standard testing procedures), and applications in which wood-protecting substances are used. A bibliography of international references is included. (Springer-Verlag, Berlin, Gottingen, Heidelberg, 1950. 571 pages, D.M. 52.50.)

Mathematical Engineering Analysis

Mathematical Engineering Analysis, by Rufus Oldenburger, is a book for the industrial research worker. Assuming a knowledge of advanced calculus, it sets up engineering problems in mathematical form. It also gives a comprehensive mathematical treatment of physics applied to specific engineering devices in the fields of mechanical, electrical and civil engineering. (Macmillan Co., New York, N.Y., 1951, 426 pages, $6.)

(*Continued on page 92*)

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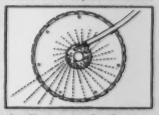

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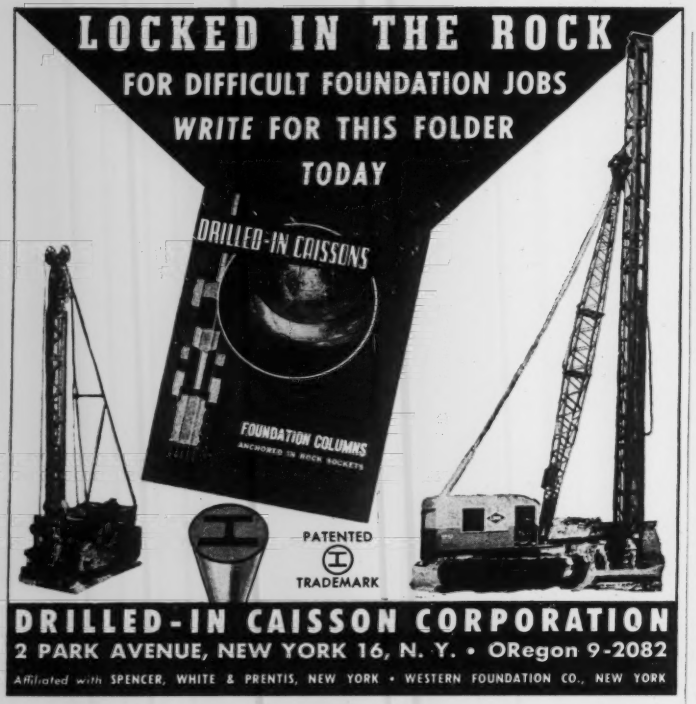
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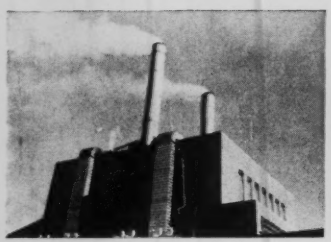

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Photos above show units number 1 and 2 of the new 150 m. w. turbo-generator steam electric station of the Pennsylvania Power and Light Company at Sunbury, Pa.

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Recent Books

(*Continued from page 90*)

Mechanical Engineers' Handbook

Covering the entire field of mechanical engineering, this fifth edition of the standard, *Mechanical Engineers' Handbook*, edited by L. S. Marks, treats fundamental theory and supplies data on the properties of materials and on the performance and characteristics of machinery, structures and processes. (McGraw-Hill Book Co., New York, Toronto, London, 1951. 2236 pages, $15.)

Mechanics of Materials

Written as a first course, the text *Mechanics of Materials* by H. D. Conway, discusses elementary stress, compound stress and strain, welded and riveted joints, and the theory of torsion. Effects of shearing, bending, stresses, and deflection due to bending in beams are considered, as well as clamped, continuous, and other types of beams. Columns and their failure under combined stresses are also treated, and the last two chapters deal with thick shells under pressure and with statical indeterminancy. (Prentice-Hall, New York, 1950. 325 pages, $6.35.)

Modern Building Inspection

This second edition of *Modern Building Inspection*, edited by Colling, Cravens and Fox, represents contributions by 18 prominent Western engineers and building officials. Known as the "Building Inspector's Handbook," the volume is an authoritative manual of sound building inspection practice. The first half treats of building department organization, records, office and field operations. Engineering matters, such as soil mechanics and foundations, structural requirements, fire resistance and building failures, are covered, and legal problems are dealt with in some detail. (Building Standard Publishing Company, Los Angeles, Calif., 1951. 646 pages, $10.)

Modern Methods of Materials Handling

The purpose of *Modern Methods of Materials Handling* by the Material Handling Institute, Inc., is to provide a broader basic knowledge for men in the materials-handling division of industry and to increase their on-the-job effectiveness. It describes a wide variety of methods and types of equipment which are in current use. After a discussion of general considerations, the special equipment and techniques for individual industries are treated in detail. Numerous photographs illustrate the text. (Prentice-Hall, Inc., New York, 1951. 248 pages, $5.50.)

Prestressed Concrete

A concise account of present knowledge of the subject, *Prestressed Concrete*, by G. Magnel, provides design data for prestressed-concrete structures. In this revised and enlarged edition, the principal changes are the addition of a chapter on statically-indeterminate multiple-story and multiple-span frames, revision of material on continuous beams, the design of end-blocks, the addition of the results of tests to the chapters on the creep of steel and buckling during prestressing, and enlargement of the chapter on applications of prestressed concrete. (Concrete Publications, Ltd., 14 Dartmouth St., Westminster, London, S.W. 1, England, 1950. 300 pages, 15s.)

Sourcebook on Atomic Energy

Important facts about the history, present status, and possible future of atomic science are surveyed in *Sourcebook on Atomic Energy* by S. Glasstone. It considers peacetime and wartime applications. Beginning with the earliest theories of the atom and its structure, the growth of thought and knowledge, the development of theories, and the discovery of the phenomenon of radioactivity are described. Radiation protection and health physics are also considered. (D. Van Nostrand Co., Toronto, New York, London, 1950. 546 pages, $2.90.)

Stratigraphy and Sedimentation

Prepared for senior students in geology, *Stratigraphy and Sedimentation* by W. C. Krumbein and L. L. Sloss, assembles and integrates facts, principles and hypotheses bearing upon stratigraphy

and sedimentation. Prerequisites include undergraduate courses in geology and related sciences. The first eight chapters deal with basic concepts, a consideration of sedimentary rocks, and the role of paleontology in stratigraphy. In the last six chapters, the fundamental facts and principles are applied to the interpretation of stratigraphic data. Selected readings from books and periodicals are also included. (W. H. Freeman Co., San Francisco, Calif., 1951. 497 pages, $5.)

The Behavior of Engineering Metals

Basic metallurgical principles in a form to help those who have not specialized in this field are presented in *The Behavior of Engineering Metals* by H. W. Gillett. Behavior of the principal commercial metals and alloys and special considerations that may influence their selection are dealt with. Corrosion, high temperatures and cost factors are discussed. (John Wiley & Sons, New York, N.Y., 1951. 395 pages, $6.50.)

The Water and The Power

A layman's story of the great rivers of the West and their development is outlined in this volume by Albert N. Williams. It treats of the effect of the rivers on the land and the people with the author's analysis of some of the political and economic factors involved in river development in the West. (Duell, Sloan & Pearce, Inc., New York, N.Y., 1951. 378 pages, $4.50.)

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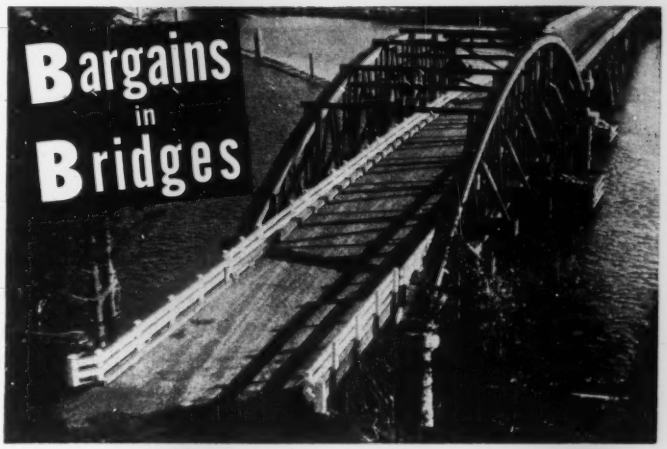
(*Continued on page 94*)



566-foot bridge across Smith River in Douglas County, Oregon. Truss section fabricated by Timber Structures, Inc.

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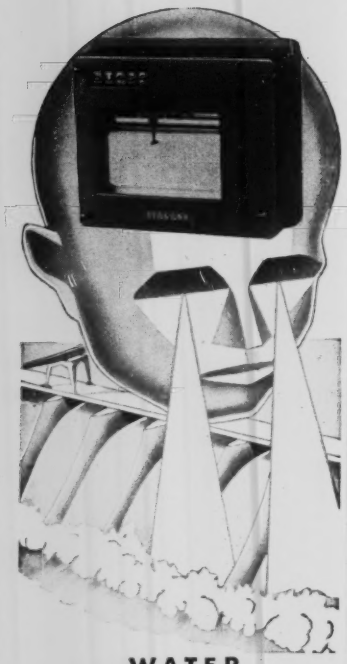

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No. 1. Filing Systems for Engineering Offices. 41 references. 1948. $2.00.

No. 2. Prestressed Reinforced Concrete. 190 references. 1948. $4.00.

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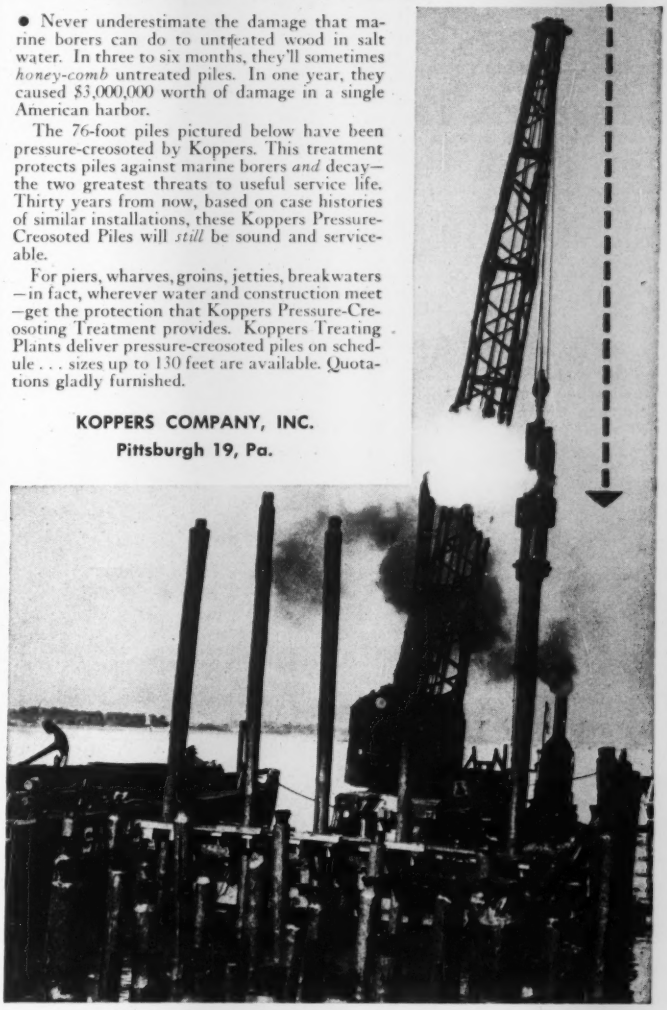

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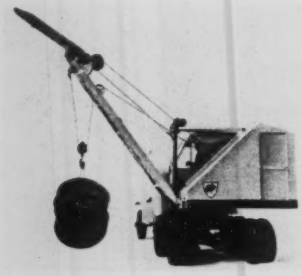

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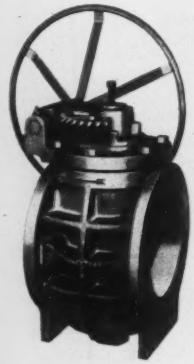

Fig. 502 GW

In the venturi-type they will have face to face dimensions identical to those of like-sized series 15 wedge gate valves; and will be designated as Fig. 512 GW for semi-steel, and Fig. 572 GW for steel. Request Reference Book 39-5, **Homestead Valve Manufacturing Company, P.O. Box 550, Coraopolis, Pa.**

Bomb Shelters

A NUMBER OF DESIGNS of steel forms for the construction of concrete bomb shelters are now being used in various parts of the country. The concensus seems to be that a concrete shell covered with a minimum of 2 ft of earth on top, reinforced with sandbags or earth at the sides, affords the maximum protection. The structure should have two exits and several openings for ventilation. Both exits must be provided with blast proof doors. The size of the shelter, depending upon the individual needs, can be constructed to accommodate many hundreds or in small units for small groups. Fundamentally, the same design can be used for any size shelter. **Concrete Forms Corp., Dept. CS, 20 Vesey St., New York 7, N.Y.**

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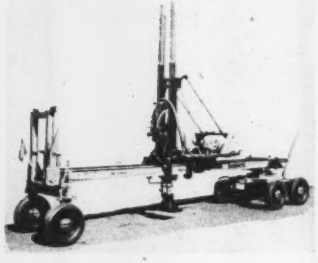
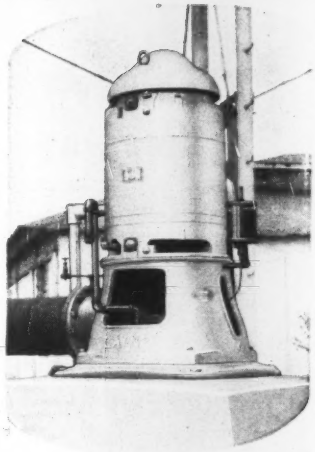


Fully Automatic

removed and the outward wheels swung around to the rear of the forward four wheels and then pivoted and located into their proper positions which gives an ordinary trailer effect for towing purposes. The machine is fully automatic, which can be instantly set to any blow desired and all that is necessary then for an operator to do is reverse the machine when it comes to the end of its carrying members. This machine can also be readily applied to a narrow, deep ditch, such as deep sewer lines and used in a trailing position. After the machine has been put in a trailing position for towing, then the hammer hinges down, lowering the top of the guides to within a few feet of the main frame. **R.P.B. Corporation, 2751 E. 11th St., Los Angeles 23, Calif.**



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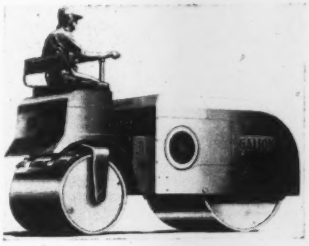

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The complete roller is raised from the ground and rides along on a set of auxiliary roller-bearing wheels equipped with stub axles and heavy-duty pneumatic tires. Other construction features listed in the specifications are: twin disc, over-center, forward and reverse clutches; combination service and parking (ratchet-type) foot brake; compression roll 48 in. diameter x 42 in. wide; 2-section steering roll 30 in. diameter x 40 in. wide—all rolls can be ballasted with water. Rolls are fitted with mats and sprinkler system. Total metal weight of roller is given as 7,650 lbs. and total ballasted weight 11,150 lbs. The tandem roller is equipped with a four-cylinder, 25 hp gasoline engine. Two speeds are provided for both forward and reverse travel—controlled by a single lever. For complete information write **The Galion Iron Works & Mfg. Company, Galion, Ohio.**

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AN AIR-COOLED, AUTOMATIC, gas-fired incinerator that completely consumes wet or dry garbage and waste material in minutes has been placed on the market. The unit is of durable steel construction so compact that it takes little floor space when installed. It consists of an airtight, heavy gauge, steel casing interlocked at four corners with upright steel posts. A three-fold insulation system that keeps the heat within the incinerator is accomplished by an insulating material within the case, a two inch circulating air space and a refractory lining that is two inches thick. A combination grate and burner assembly

(*Continued on page 98*)

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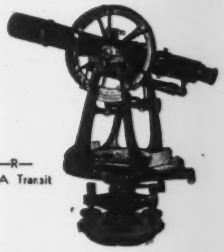

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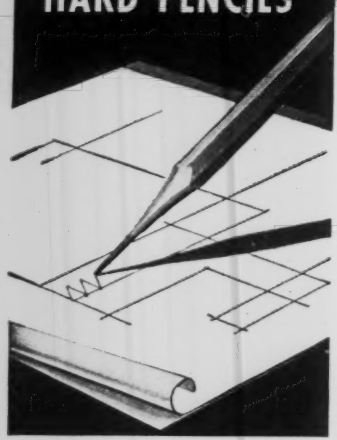

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Equipment, Materials & Methods (Continued)

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Super C Tournadozer

THE SUPER C TOURNADOZER available with torque converter and electric control is now being built. The torque converter is a single-stage type, which acts as an automatic hydraulic transmission, combining the advantages of a hydraulic torque converter and a hydraulic coupling. It transmits and selects the proper ratio for delivering power in a steady, even flow to the wheels and provides a shock load cushion between the engine and the drive wheels which allows the engine to operate at maximum rpm. Lugging of the engine is eliminated. This provides maximum torque when needed (particularly when starting), and permits smooth acceleration to all speed ranges which cuts down tire slippage and wear. The various gears in the constant-mesh, air-actuated Tournamatic transmission now are controlled by electro-magnetic valves placed in the air lines going to the clutches which engage the transmission gears. These valves are controlled by 4 push-pull finger tip switches mounted on the dash panel. With finger tip electric control, air actuated transmission gear changes into higher or lower ratios are instantaneous, thereby eliminating loss of momentum. Another development is that electrically-controlled steering is now accomplished by use of a toggle switch mounted on the control panel. The Tournadozer is turned by pushing a switch in the desired direction to actuate synchronized electro-magnetic valves in the air lines controlling the clutch and brake discs. **News Bureau, R. G. LeTourneau, Inc., Peoria, Ill.**

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L. J. Ritter, Jr.; R. J. Paquette,
Both of the University of Florida

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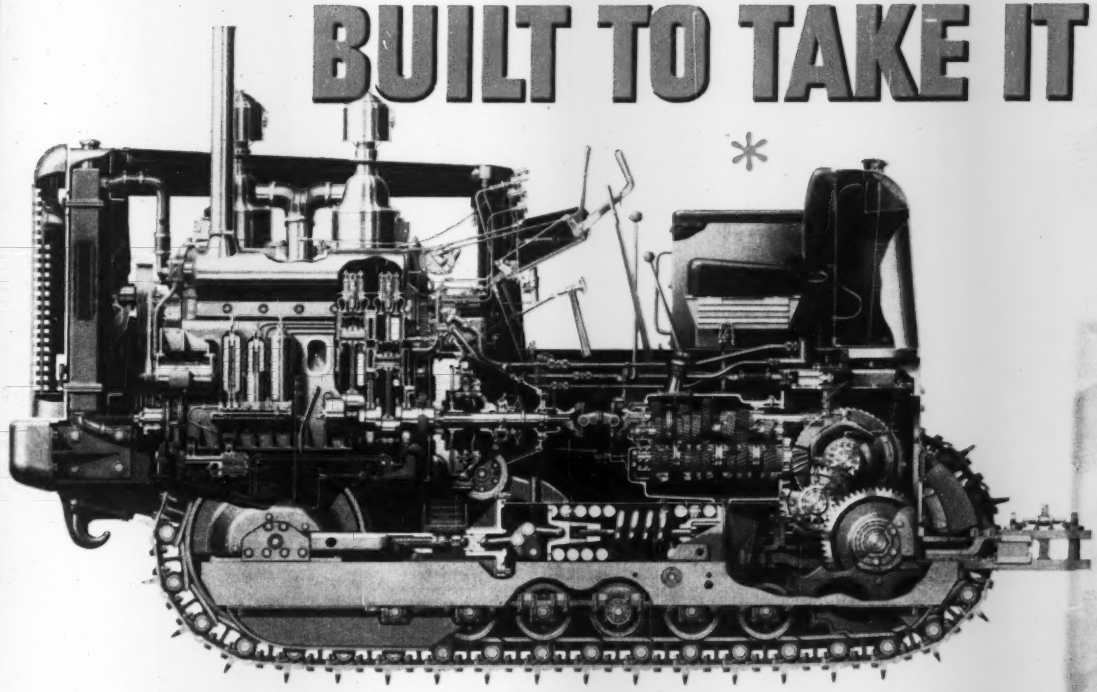

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Equipment, Materials & Methods (Continued)

Fluoridizer

AN IMPROVED FLUORIDIZER for the feeding of fluoride chemicals to water supplies is announced. Known as Model 47-A, this scale mounted feeder features large hopper capacity, dustless filling, and low filling height; all improvements to the feeder. To avoid the need for frequent filling, this hopper will hold, not one but, two 100 lb bags of fluoride or one 125 lb drum carton. Dust production during filling is eliminated by preventing the fall of chemical through the air. The chemical is added at the bottom of the hopper. This is made possible in the following manner: A bag of chemical is placed on the hopper door, skewered in place, slit open at the top and the door merely swung up and closed, allowing the chemical to fall but a short distance into the hopper. The low filling height is accomplished not only by lowering the hopper since the dissolving chamber is off the scale, but also by the method of placing the bag or carton on the hinged side door to the hopper. In addition to these new and improved features, the fluoridizer has accuracy of feed, check of quantity fed, positive volumetric displacement, simple mechanism, and drive, simplified lubrication, wide feeding range, percentage adjustment of feed scale, and engineered design to allow for either large or small dissolvers. **Omega Machine Company, 345 Harris Ave., Providence 1, Rhode Island.**

High-Head Pumps

A COMPLETELY REDESIGNED LINE of two-stage pumps, designated as Type DMD, is announced. In the redesigning process, the pumps have been improved with regard to compactness, pumping efficiency and mechanical ruggedness. Type DMD pumps are made in sizes from 2 in. to 10 in. discharge; capacities up to 4000 gpm and heads to 750 ft. The two-state design is effective in that a single DMD pump, driven by a single motor, produces as much head as two single stage pumps piped in series. The DMD pump is an economical unit for rugged service, incorporating many mechanical features to assure long and reliable service. Among outstanding features listed are: A horizontally split casing with interconnecting passage between the two opposed impellers. The impellers are the non-overloading type, hydraulically and dynamically balanced at the factory. The large diameter shaft is carried on heavy duty cartridge-type dust proof ball bearings. For thrust, an angular contact duplex bearing is used. Radial load is supported by a double row ball bearing. **Economy Pumps, Inc., Div. of Hamilton Thomas Corporation, Hamilton, Ohio.**

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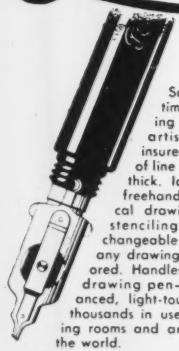

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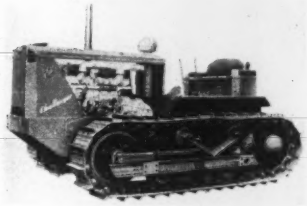
Equipment, Materials & Methods (Continued)

Crawler Diesel Tractors

A LINE OF CRAWLER DIESEL TRACTORS and equipment produced by the internationally known firms of John Fowler & Co. (Leeds) Ltd., and Marshall Sons & Co., Ltd., both of England, are available. The



Diesel Powered

crawler diesel tractors range from 95 hp down to 20 hp. These tractors can be obtained from their U.S. distributor **John M. H. Shline Company, 342 Madison Ave., New York 17, N.Y.**

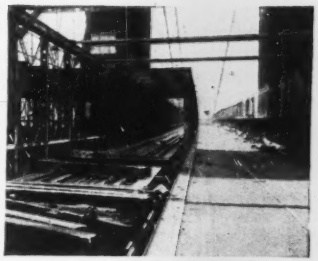
Diesel Pile Hammer

A SELF-CONTAINED DIESEL PILE HAMMER which requires no auxiliary equipment—such as steam boilers or air compressors—to maintain pressure is now available. This revolutionary pile driving tool is 15 ft 6 in. long, has a 20 in. diameter, and weighs 11,000 lbs. Despite this compact size and light weight, the hammer delivers driving energy at the rate of 16,000 ft lbs per stroke, and is capable of 84 strokes per minute. The weight of the ram or the striking part is 5,400 lbs; the maximum power stroke is 4 ft. The hammer fits in standard 20 in. leads, can easily be handled by a gasoline or diesel operated crane and requires two lines—one for lifting the hammer; the other for lifting the pile and for starting the hammer by lifting its piston. One-man operated, the force of each blow is remotely controlled by means of a hydraulic system which operates similarly to automotive hydraulic brakes. The force of each blow can be easily varied from zero to full power, and the unit will idle without impact and without stalling. **Syntron Company, 555 Lexington Ave., Homer City, Pa.**

Portable Conveyor

BRIK-TOTER, the portable conveyor which takes the "hod" work out of building, can be purchased now with a gasoline engine drive for use where electricity is not available. The outstanding features of the conveyor, including low first cost, portability, and labor savings are unchanged. Savings of between 40 percent and 70 percent, depending on application, are reported by users. The gas engine is a

(*Continued on page 102*)



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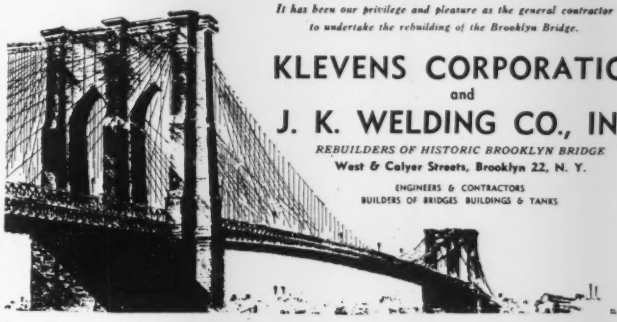

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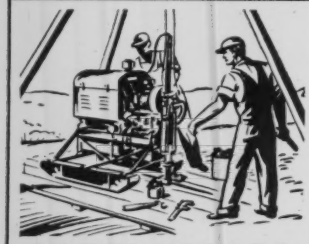

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Equipment, Materials & Methods (Continued)

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THE ELECTRO SONOMETER is used for determining the resonant frequency of any solid mass or material where strength is an important factor. It is used to measure such materials as: aluminum, carbon electrodes, castings, ceramics, concrete, plastics, pressed materials, steel beams, etc. The electro sonometer consists of two units: the control cabinet and the portable pick-up. The control cabinet contains an amplifier supplying 18 watts of power at the driving unit which permits measurement of resonance frequency, with a good degree of accuracy, in solid masses weighing up to 1500 lbs. Regulated by a single control, an unusually wide latitude of driving power is possible, ranging from a low of a fraction of a watt to a high of 18 watts. An accurate oscillator measures resonant frequency from 20 cycles to 22 kilocycles. The phase relationship between the driving voltage at one end of the mass and various points within the mass can be determined and viewed on the screen of the cathode ray oscilloscope. This enables experienced operators to determine the flexural and torsional modes of vibration. **Electro Products Laboratories, 4501 Ravenswood Ave., Chicago 40, Ill.**

Flexible Recorder

THE PRECISION-MADE AUTOGRAPHIC recorder is so compact and versatile in operation, that it can be applied to any one of a wide variety of operations in the physical testing field. The portable, self-contained recorder of the X-Y Type is an invaluable aid in obtaining stress-strain records. It is usually employed in conjunction with a testing machine and extensometer equipment. The Model MD-2 is readily convertible to numerous other applications which require the recording on rectangular coordinates of simultaneous relationship between any two variables that can actuate microformers. The unit is equipped with rubber feet for use on table surfaces. Its approximate dimensions are 14 in. long × 10 in. wide × 13 in. high. Total weight of the assembled unit is about 50 lbs. **Baldwin-Lima-Hamilton Corporation, Equitable Bldg., 120 Broadway, New York 5, N. Y.**

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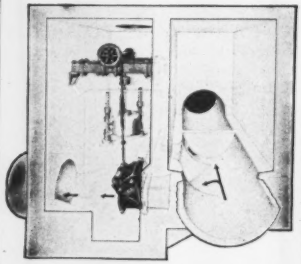

Fig. B-19

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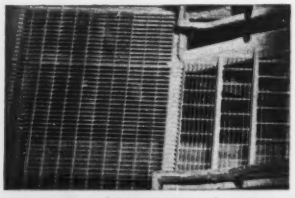

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Equipment, Materials & Methods (Continued)

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The Tru Point

insert pencil in the guide, and rotate the cover; the more revolutions, the finer will be the point. The Trupoint will also point up wood pencils, if the wood is cut back beforehand with a knife. It is sturdily built with a heavy cast base, to give years of service, and the mechanism is guaranteed. Abrasive liners are low in cost and easily replaced. **Elward Mfg. Co., 557 Paw Paw Ave., Benton Harbor, Mich.**

Lodover

ESPECIALLY DESIGNED for civilian defense bomb shelter tunnel and protective construction is the underground Lodover, a special adaptation of the standard Lodover. The underground Lodover, a combination over-head and front-end tractor loader, loads overhead in a 14 ft shaft. No turn overhead operation doubles track life on rock and reduces wear at 19 points in the crawler assembly. No turn overhead operation often steps up production as much as 50 percent, because there is no time out for turns. Equipped with the special $1^1/_4$ yd heavy duty rock bucket, the Lodover can dig its own sloping ramp in and out of the tunnel or shaft. Other advantages include all hydraulic operation, easy on the operator and easy on the tractor. Many useful attachments, including a dozer blade, angle blade, winch boom, lift fork and snow plow, add to the Lodover's versatility. Manufactured for International Harvester tractors by **Manufacturing Division, Service Supply Corporation, Philadelphia 32, Pa.**

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Literature Available

SHIP GRATINGS AND TREADS—A pamphlet on ship grating and treads which will be of interest to those interested in marine engineering has recently been published. It contains safeload tables, weights, panel widths, etc., and various types and sizes of mesh of Irving grating and treads, applied to merchant and naval vessels. **Irving Subway Grating Co., Inc., 5009 27th St., Long Island City 1, New York.**

WATERPROOFING—Bulletin No. 102, a three page folder and Bulletin No. 103, a seven page pamphlet gives technical information and specifications on Nervastral Seal-Pruf, a flexible sheeting of very high impermeability for window flashing, spandrel waterproofing, moisture vapor barrier, membrane waterproofing, and similar applications. **Rubber & Plastics Compound Company, Inc., 30 Rockefeller Plaza, New York, N. Y.**

INDUSTRIAL AND MARINE HARDWARE—A new, revised and enlarged data book, combining valuable engineering information with an extensive catalog of the most complete line of wire rope and chain fittings, is offered. In addition to presenting detailed working characteristics of each product to remove guesswork in selecting the proper fitting, tables and charts are included which make Catalog No. 150 a valuable reference book for engineers, architects, riggers, and safety directors. **The Thomas Laughlin Company, Portland 6, Maine.**

SOUND FILM CATALOGUE—Seventy-two sound films that cover general interest subjects, product information, and training and instruction courses are listed in a 1951 sound-film catalogue. Divided into three sections for easy reference, the catalogue provides a page of descriptive text (with illustrations) for each film. Under each title is a list of people the particular film should interest; and film size, projection time, type of film, and shipping weight are given. Six basic rules of operation are provided to ensure a successful film showing, and how-to-order information is included (film order forms mailed with catalogue). Ask for Catalogue B-4761, **Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa.**

"RUNABOUT" DITCHER—An 8-page two color folder describing the Model 705-A "Runabout" service ditcher is announced. One of the most valuable features of the folder is a table which describes six types of tile and pipe types and diameters, matching these specifications with the digging widths—5½ in., 7½ in., and 10½ in., available with the "Runabout." The folder further explains the operation of the Hydra-Crowd hydraulic transmission which provides an infinite range of digging speeds from 0 to 16 ft. per minute, in conjunction with bucket line speeds of 380, 649 and 1,152 ft per minute. All other features of the "Runabout," are fully described and illustrated with photographs and drawings. **Barber-Greene Co., Aurora, Ill.**

(*Continued on page 106*)

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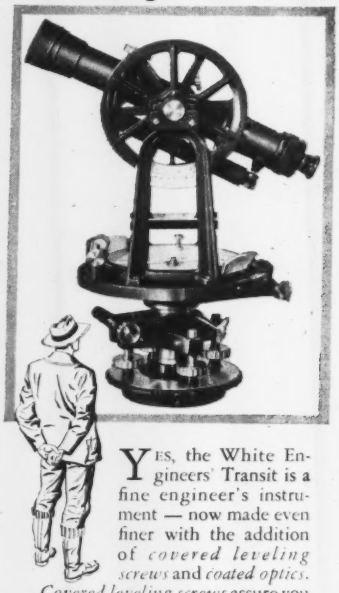

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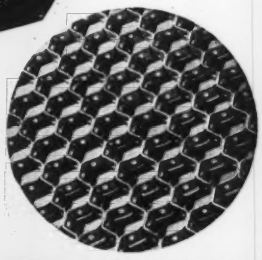

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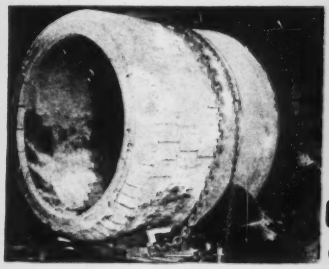

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Literature Available (Continued)

MATERIALS HANDLING REPRINT—A 16-page booklet entitled, "Aluminum in Materials Handling," contains a collection of seven articles on how the lightweight metal saves manpower and effects other economies in modern handling equipment. **The Aluminum Assoc., 420 Lexington Ave., New York 17, N. Y.**

POCKET SIZED CATALOG—The 1951 Athey Products condensed pocket size catalog, shows all the products or variations of what Athey builds and has to sell. This size catalog, designed to fit in the inside coat pocket, is a new innovation in the heavy construction industry. It provides immediate reference and eliminates the necessity of referring to files or catalogs. **Athey Products Corp., 5631 West 65th St., Chicago 38, Ill.**

SOIL TESTING—A 12-page catalog No. 3-51, on new products in the soil testing apparatus line has been released. Included in the items illustrated and described in the bulletin are the Soiltest models of triaxial and consolidation apparatus and accessories, paraffin warmers, dispersion mixers, direct shear apparatus, laboratory and field California Bearing Ratio apparatus, humidifiers, etc. **Soil Testing Services, Inc., 4520 W. North Ave., Chicago 39, Ill.**

PUMPS—Bulletin B-2300 comprehensively covering the company's horizontal Fluidyne pump line, has been published. Two types of pumps are offered in the line. One is a close-coupled electric motor driven pump, designated as the Peerless Type PE. The other, designated as the Peerless Type PB, is a bracket-mounted pump for driving through a flexible coupling, of V-belt, or flat-belt pulley. **Peerless Pump Div., Food Machinery Corporation, 301 West Ave. 26, Los Angeles 31, Calif.**

ROOFS—Those concerned with roof maintenance will find "Solving Roof Problems," an attractive 32 page brochure, to be an absorbing and authoritative discussion of the matter. Illustrated by photographs, drawings and diagrams, the booklet thoroughly explores such subjects as the various types of roofs, how they are built, what factors enter into their deterioration and how roof troubles can be diagnosed and treated. **The Tremco Manufacturing Company, 8701 Kinsman Rd., Cleveland, Ohio.**

WATER FILTERS—A 6-page bulletin just published, describes in detail the company's line of Model SC filters. These compactly-built, self-cleaning filters are designed to filter large volumes of water and other liquids rapidly and at low cost. The attractive bulletin, printed in color, clearly illustrates the heavy-duty construction of the Model SC, shows several typical installations, includes prints showing arrangements of necessary piping, and gives full specifications. **Sparkler Mfg. Company., Mundelein, Ill.**

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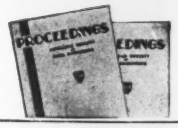

PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 108.

Summarized in Earlier Issues

56. Turbulent Transfer Mechanism and Suspended Sediment in Closed Channels, by Hassan M. Ismail.

57. Design of Irrigation Systems, by W. H. Nalder.

58. Highway Planning in Turkey, by H. E. Hilts.

59. Limit Design of Beams and Frames, by H. J. Greenberg and W. Prager.

60. Surveying and Mapping Requirements for Modern City Planning, by Charles A. Blessing.

D-7. Discussion of Paper, **The Geochemistry of Earthwork,** by Hyde Forbes.

D-XXV. Discussion of Paper, **Numerical Computation of Buckling Loads by Finite Differences,** by Mario G. Salvadori.

61. Structural Damping in Suspension Bridges, by the late Friedrich Bleich and L. W. Teller.

62. The New Towns Program in Great Britain, by T. C. Coote.

63. National Geodesy—Status and Planning, by Leo Otis Colbert.

D-8. Discussion of Paper, **Floating Tunnel for Long Water Crossings,** by Charles E. Andrew.

D-11. Discussion of Paper, **Long-Term Storage Capacity of Reservoirs,** by H. E. Hurst.

D-16. Discussion of Paper, **Pavement Bearing Capacity Computed by Theory of Layered Systems,** by Guthlac Wilson and G. M. J. Williams.

D-19. Discussion of Paper, **Flood-Control Operation of Tennessee Valley Authority Reservoirs,** by Edward J. Rutter.

D-23. Discussion of Paper, **Influence of Heavy Loads on Pavement Design Trends,** by K. B. Woods.

Third Notice

64. Planning the National Capital: Objectives and Problems of Attainment, by Ulysses S. Grant III. The important contribution made by engineers to the planning and development of Washington, D.C., is detailed. Discussed briefly are the current major problems of the city and the measures taken for their solution. The need for legislation to enhance the effectiveness of the Planning Commission is explained, and a federal and interstate Metropolitan Works Agency to provide for the financing and design of construction work needed by the metropolitan area as a whole is advocated but not as the direct responsibility of any one of the political jurisdictions. (Available May 1.)

65. National Topographic Mapping, by W. E. Wrather. The present status of topographic mapping of the United States and the rapid rate of obsolescence of the older topographic maps are discussed, together with standards and specifications that are expected to decrease the rate of obsolescence of modern quadrangle maps. The paper explains the manner and extent of cooperation in effect between the Geological Survey and other federal and state agencies for the purpose of expediting progress on the national topographic mapping program and the practicability of a 20-year schedule for completing standard topographic quadrangles of the United States. (Available May 1.)

66. Lateral Forces of Earthquake and Wind, by a Joint Committee of the San Francisco, Calif., Section, ASCE, and the Structural Engineers Association of Northern California. This paper develops a dynamic criterion for design lateral earthquake and wind forces and a provision for building codes based on this criterion. The earthquake shear transmitted from the ground to a structure is related to the weight and natural period of vibration of the structure. This shear is resolved into lateral forces at various levels. The lateral force code, drawn for California conditions, is generally applicable with some modification. (Available May 1.)

D-13. Discussion of Paper, **Reinforced Concrete Skewed Rigid-Frame and Arch Bridges,** by Maurice Barron. The original paper, published in April 1950, presented a method of analysis and design that indicates the effect of skew on a barrel arch or rigid-frame structure. Discussers are: D. A. Nettleton, Ernest H. Harder, Egidio O. Di Genova, Kuang-Han Chu, Harold E. Levenson, Walter L. Schwartz, Leo Sos, Leif Arup, and Maurice Barron. (Available May 1.)

D-18. Discussion of Paper, **Successive Approximations for Beams on an Elastic Foundation,** by E. P. Popov. The original paper, published in May 1950, gave a general method for solving problems of variable moment of inertia of a beam and variable foundation modulus. Discussers are: Ralph E. Fadum, J. V. du Plessis, W. E. Hanson, Jacob Karol, E. E. De Beer and D. Krsmanovitch, and E. P. Popov. (Available May 1.)

D-21. Discussion of Paper, **Maximum Load Capacity of Bailey Bridges,** by Robert B. Stegmaier, Jr. The original paper, published in June 1950, reviewed the use of load tests in determining the maximum capacity of military bridges. Discussers are: D. Allan Firmage, and Robert B. Stegmaier, Jr. (Available May 1.)

Second Notice

67. Model and Prototype Studies of Sand Traps, by Ralph L. Parshall. Two successful methods of controlling the deposition of waterborne gravel and sand in power and irrigation canals are discussed and illustrated. The vortex tube and riffle deflector have proved effective in trapping the bed load in actual installations as well as in laboratory tests. The design and operation of these devices is outlined and their relative efficiencies are compared. (Available June 1.)

68. International Cartography, by Robert H. Randall. Modern transportation and communication facilities have made it imperative to secure cartographic cooperation on a much wider basis than in the past. Attempts to secure such cooperation among the nations of the world are described. The purposes, methods of operation, and accomplishments of sev-

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5. Discussions of each paper, with author's closure, also will be published as a Separate and must be ordered in the same manner as other Separates, except that no charge will be made for the discussions of a paper previously ordered. The order form will list available discussions of papers. Discussions will be numbered to agree with the basic paper.

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eral international cartographic organizations are given as well as details of United Nations participation in the planning. (Available June 1.)

69. Valuation and Depreciation Related to Income Tax, by Maurice R. Scharff. This paper supplements a previous paper by suggesting a procedure by which income tax can be taken into account in economic comparisons of engineering projects and in valuations of public utility property, based upon present worth of earning power. In effect income tax is treated as an additional fixed charge on investment. Algebraic formulas are presented and illustrated by examples. (Available June 1.)

70. Regime Theory for Self-Formed Sediment-Bearing Channels, by T. Blench. Major river diversions for irrigation have proceeded in India since 1890 under conditions of (1) sediment-laden water, (2) excavated canal boundaries of erodible alluvium, and (3) very flat country. Rational formulas have been developed for the final self-adjusted dimensions of such canals. The formulas fit and amplify the framework of rigid-boundary hydraulics. Applications are made to the consequences of intertering with river regime. (Available June 1.)

71. Rectification of the Papaloapan River in Mexico, by Reynaldo Schega. The Papaloapan River in Mexico is undergoing rectification by means of six cutoffs, as a first major step in a comprehensive development of its basin for flood control, navigation, and power production, undertaken by the government of Mexico. The system of cutting off river bends by excavating pilot cuts that the river subsequently enlarges into full-sized channels is patterned after that adopted on the Mississippi River. The status of the project two years after the pilot cuts were dug is presented, illustrated by aerial photographs. (Available June 1.)

D-24. Discussion of Paper, **Buckling of Rigid-Jointed Plane Trusses,** by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman. The original paper, published in June 1950, gave rigorous methods of calculating the elastic restraint of adjacent members on a compression member and also of determining the effect of gusset plates on rigidity. Discussers are: Jacob Karol; Alfred S. Niles; Thomas C. Kavanagh; George Winter and Oliver G. Julian; N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman. (Available June 1.)

D-27. Discussion of Paper, **Plasticity of Metals—Mathematical Theory and Structural Applications,** by D. C. Drucker. The original paper, published in August 1950, emphasized the importance of plasticity in elastic design and illustrated the use of elementary plastic analysis. Discussers are R. W. Steed, Jacob Karol, S. K. Ghaswala, and D. C. Drucker. (Available June 1.)

D-28. Discussion of Paper, **Retrogression on the Lower Colorado River After 1935,** by J. W. Stanley. The original paper, published in August 1950, discussed the control of floods and sediment deposition in the lower Colorado River made necessary by the construction of Hoover Dam. Discussers are: T. Blench, E. W. Lane, and J. W. Stanley. (Available June 1.)

First Notice

-72. -Design of Large Coal Bunkers, by Paul Rogers. Design procedure is presented for large capacity coal bunkers. Coal pressures by the shallow bin formula and by modified deep bin formulas are reviewed, pressures on inclined wall analyzed, and values tabulated. Bunker walls are presented as flexible plates and inward forces analyzed. Unbalanced forces due to unsymmetrical layouts are investigated. The paper advocates design by continuity for the stiffeners, and the inclusion of the bunker plates in the design of stiffeners is emphasized. Several illustrations and tables are included to facilitate quick and economical design. (Available July 1.)

73. Health Implications of Air Pollution, by J. J. Bloomfield. The need for control of air pollution is especially urgent in view of the increasing industrial activity with attendant pollution of the atmosphere. Studies have shown a definite relationship of air pollution to health. The study of the Donora smog of October 1948, during which 6,000 persons were affected (20 of them fatally) confirmed the acute threat of air pollution and pointed the way to consideration of long-range, or chronic, effects. Reduction of the pollution load is not always economically feasible with available devices, but research and restriction should aid in the solution of the problem. The engineer in industry can play an active part in this rapidly expanding field. (Available July 1.)

74. Acceptable Standards for Natural Waters Used for Bathing, by Charles R. Cox. Increasing interest in the public health aspects of bathing water quality has led to a study of standards suitable for the control of these waters. Quantitative bacteriological standards are difficult to apply without supplementary sanitary surveys and the exercise of seasoned administrative judgment. Methods of evaluating pollution have not developed sufficiently to permit assuming absolute standards. The connection between pollution of bathing waters and illness of the rising population has not been investigated thoroughly. (Available July 1.)

75. Base Course Drainage for Airport Pavements, by Arthur Casagrande and William L. Shannon. Observations on a number of airfields are described illustrating the principal causes for the saturation of base courses of airfield pavements. A theoretical analysis of the drainage of saturated base courses is presented and working formulas are recommended. Laboratory tests on fluid models and full-scale field tests are described and their results compared with the theoretical formulas. The recommended design procedure is illustrated by means of an example. (Available July 1.)

76. Model Tests Using Low-Velocity Air, by James W. Ball. The use of low-velocity air testing to solve flow problems pertaining to hydraulic conduit systems and equipment is presented. How this method of testing may be used as an inexpensive expedient in obtaining complete or partial solutions to hydraulic problems is outlined. Limiting velocities, advantages, disadvantages, precautions, comparison with hydraulic tests, and specific examples are discussed. (Available July 1.)

D-25-K. Discussion of Paper, **Uplift Pressures in Concrete Dams,** by Kenneth B. Keener. The original paper, published in June 1950, described the installation and location of equipment used to observe uplift in concrete dams and gave methods of relieving this uplift. Discussers are: Ross M. Riegel, William P. Creager, A. Warren Simonds, Fairfax D. Kirn, Serge Leliavsky Bey, A. M. Davison, Duff Abrams, and Kenneth B. Keener. (Available July 1.)

D-29. Discussion of Paper, **Sedimentation Studies at Conchas Reservoir in New Mexico,** by D. C. Bondurant. The original paper, published in August 1950, presented data on the form and extent of sediment deposits at Conchas Reservoir and emphasized the importance of considering sedimentation in reservoir design. Discussers are: T. Blench and D. C. Bondurant. (Available July 1.)

D-32. Discussion of Paper, **Effect of Skew Angle on Rigid-Frame Reactions,** by Walter C. Boyer. The original paper, published in September 1950, presented methods of analysis of the skewed rigid-frame bridge that reduce the arduous labor of design of such structures. Discussers are: D. A. Nettleton, Maurice Barron, and Walter C. Boyer. (Available July 1.)

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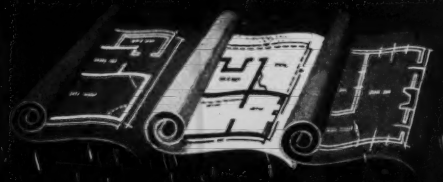

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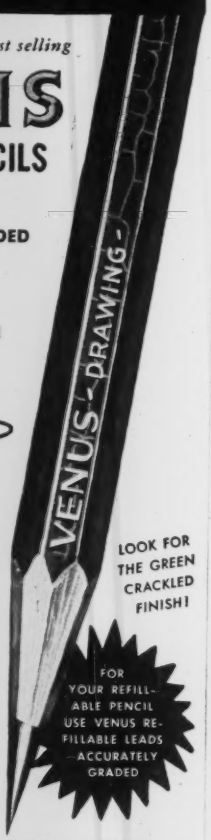

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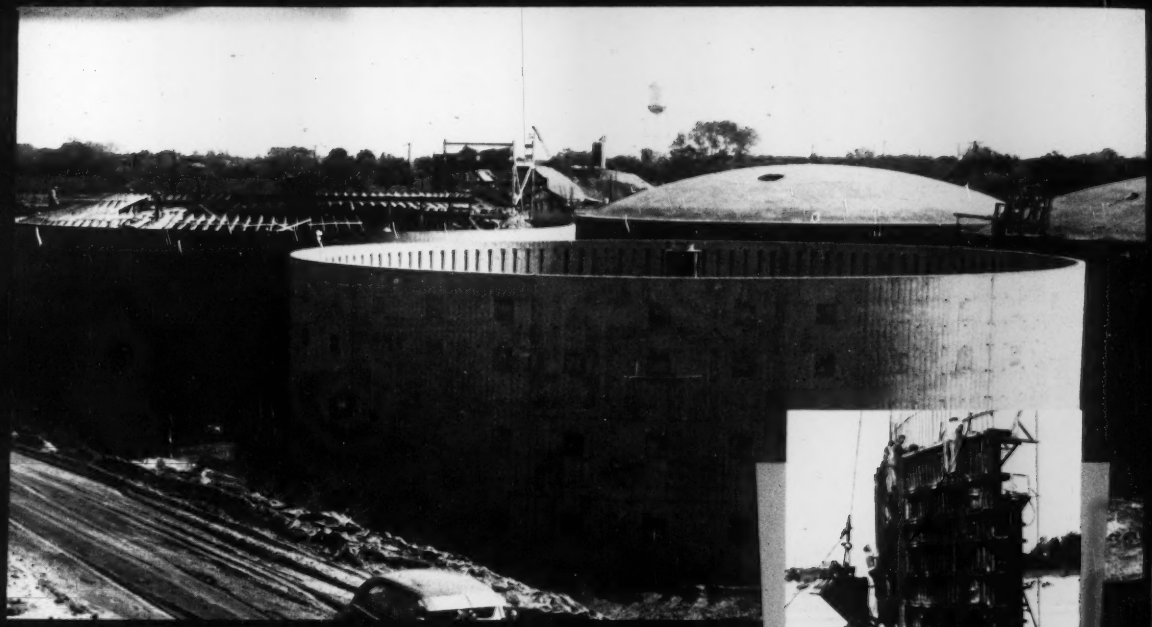

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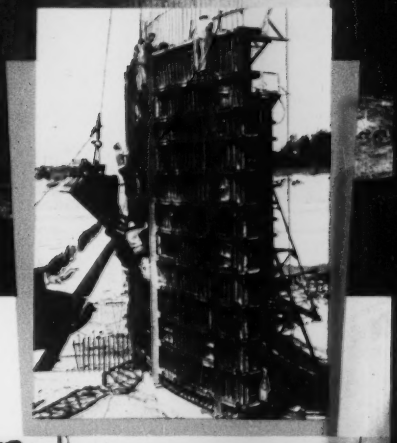

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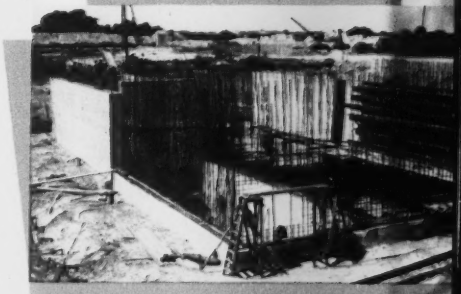

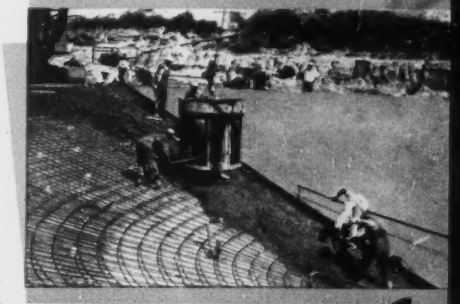

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